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Importance of Color in Hand-Blown Glass

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Increasing sales of colored hand-blown glass for decorative and functional purposes have contributed greatly to the continuing growth of the industry. In 1959 the value of production totalled $31,500,000, and for that same period, colored glass represented 90 per cent of output at Blenko.*

Glass blowing originated during the ancient Egyptian Ptolemaic Period. The earliest pieces were blown from a cylinder closed at one end; later a metal tube or pipe was used to shape a form from a bubble.

In the First Century A.D., the Romans developed the technique of making small window panes. Some magnificent glass pieces are attributed to this period. However, with the fall of the Roman Empire, the advanced methods were lost. The Venetians mastered the craft in the Fifteenth Century after learning the rudiments from the Far East. Although the Venetians guarded their techniques well, even to the extent of isolating artisans on an island, the craft nevertheless spread to Poland, Germany, and England.

When the English founded the Jamestown colony in Virginia, they established a small glass works, making glass blowing the first American industry. Ideal sand and calcium sources in the area promoted the growth of this craft. Furthermore, the glass blowers could produce bottles for shipment to England, as well as beads with which the settlers could barter with the Indians.

The Industry Today

There is hardly any similarity between today's glass industry and the small medieval workshops, save for one factor—the craftsman. He was, and still is, the nucleus of the industry. In this era when man must submit to increasing automation out of necessity, the craftsman's skill serves a dual purpose: *(1)* the market demand for a product that is the result of man's creativity and energy is satisfied, and *(2)* this product is a source of design inspiration for the mass market.

Before glass production begins, a batch containing cullet, i.e., waste glass, metallic oxides for coloring, fine sand, and other glass-making materials, is melted in a clay pot. The pots hold approximately 3000 lbs. of glass and one can be worked out in 8 hours or less, depending upon the size of the items being blown. At Blenko, thirteen pots and five day tanks are used to melt the glass. The temperature remains at 2500°F for 36 hours, and is then lowered to a working temperature of 1900°F.

When a simple bowl or pitcher is blown, a 6- to 10-man team, referred to as a shop, is required. Although no actual training program exists, a type of apprenticeship system prevails. Within a five- to eight-year period, a physically sturdy person can progress from one job to another, continually increasing his skill.

Skills Required

BLOWER — Trained to distribute the main weight of the glass gob. His key skill is weight balance.

*According to the Bureau of Statistics.

Fig. 1. A molten ball of glass on a blowpipe being prepared for blowing into a cylinder.

Fig. 3. Blown cylinder being placed in annealing lehr.

FINISHER	Responsible for final shape of glass. He must have a keen sense of proportion.
GATHERER	Must judge correct amount of glass to take from the clay pot to blow a specific piece.
BIT GATHERER	Gathers glass gobs on the pontil for stems, handles, etc.
STICK UP	Attaches the pontil to the blown piece.
CARRY IN	Must pick up the completed object while it is still hot.

Within a shop, a blower, finisher, gatherer, bit gatherer, stick up, and carry in work as a closely knit team. Since a glass piece can be finished in a very short time, some in only a few seconds, it is extremely important that each worker do his task without disrupting the rhythm of the operation.

Fig. 2. Glass in final stage before blowing cylinder.

Tools

Standard tools used in the shop include a blow pipe, puccella, pontil, shears, wooden paddles, and molds. Varying in length and diameter, depending upon the size of the piece to be blown, the blow pipe is a solid metal tube, often about 54 in. long.

The puccella is a tong-like shaping instrument and the pontil, a solid pipe, is attached to the bottom of the piece for maneuverability. The shears are utilized

Fig. 4. Finisher shaping pitcher handle that has just been applied. Tools on bench include shears and puccella.

Fig. 5. Pontil being removed by finisher. Carry in is holding completed piece with asbestos fork.

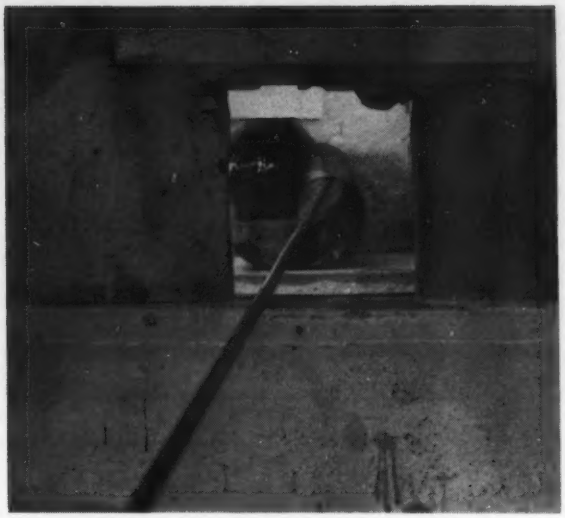

Fig. 7. Cylinder being flattened into a sheet.

in snipping off excess pieces of material. To smooth the surface, wooden paddles are used, and to create various textured areas, the blower blows a hot mass of glass in a wooden mold.

Manufacturing Process

After the gatherer heats the blow pipe and collects molten glass on it, the blowing process begins, and the blower inflates the hot mass into a shape, perhaps a small pitcher, hurricane shade or a giant bottle. Sometimes he uses a wooden mold, especially if a textured surface is desired, since free-blown pieces are rather smooth.

Unless the blower wants to twist the shape, he must constantly rotate the blow pipe. When the initial contouring is completed, the stick up attaches the pontil to the bottom of the piece. The blow pipe is removed and the stick up cuts away any excess material.

At this point the glass is reheated and the finisher, at his work bench, contours the shape in proper proportion and levels the surface with a wooden paddle. If handles or spouts are required, the gatherer collects the hot liquid on a pontil and the finisher works it onto the piece. The blower is responsible for the making of stems.

As soon as refinishing is completed, the carry in takes the object to the annealing lehr with an oversized asbestos fork. At the mouth of the lehr the temperature is 1000°F, and the glass is conditioned against breakage as it is transported through lessening temperatures on a continuously moving chain belt.

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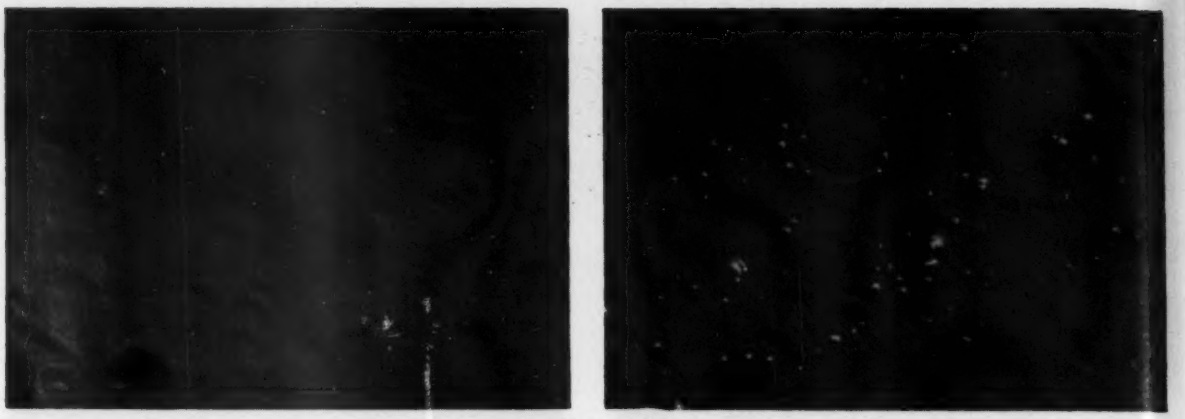
Fig. 6. Cylinder being placed in flattener preheating chamber.

Fig. 8. Flattened sheet being placed into annealing lehr.



Magnification 1400

FIG. 1. Initial surface in comparison with the surface having scum propagation at preferential sites.

A Study of Glass Surface D

I. Introduction

● MOISTURE-VAPOR ATTACK OF GLASS SURFACES occurs under atmospheric conditions in humid environments. Water vapor combines with the chemical constituents of the glass, forming visible reaction products that appear on the surface as either a light haze or a heavy accumulation. This type of surface activity is described in the literature[1] as scumming and staining of glass. Deterioration of the surface is due to a solvent action between the condensed moisture and the alkali that has migrated to the surface from the glass network. In addition, hydration reactions are possible with silicon and other cations, while subsequent chemical action on the surface may form either hydroxides, carbonates, complex silicates or a thin silica gel film.

As more concentrated droplets develop on the glass surface, the adsorbed moisture continues to dissolve the constituents on the surface of the glass and the solute within the droplet may attain a sufficient concentration to cause etching or pitting of the surface. In the advanced stages a deterioration of the surface is indicated by heavy frosty deposits and the appearance of surface cracks. The frosty accumulations are siliceous and are classified as scum; whereas any etching or penetration into the surface during the chemical reactions is considered stain. Other means for differentiating between scum and stain are based on ease of removal from the glass surface. Scum is essentially a deposit that can be removed by cleaning the surface with pumice and water. Stain is not removed by pumice cleaning and persists

FIG. 2. With continuation of scumming, coverage of the surface becomes more pronounced.
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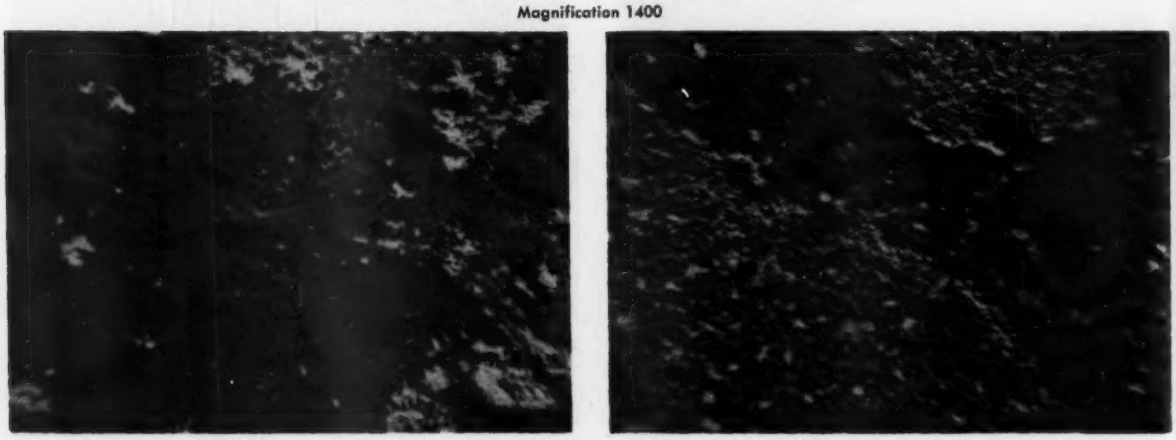

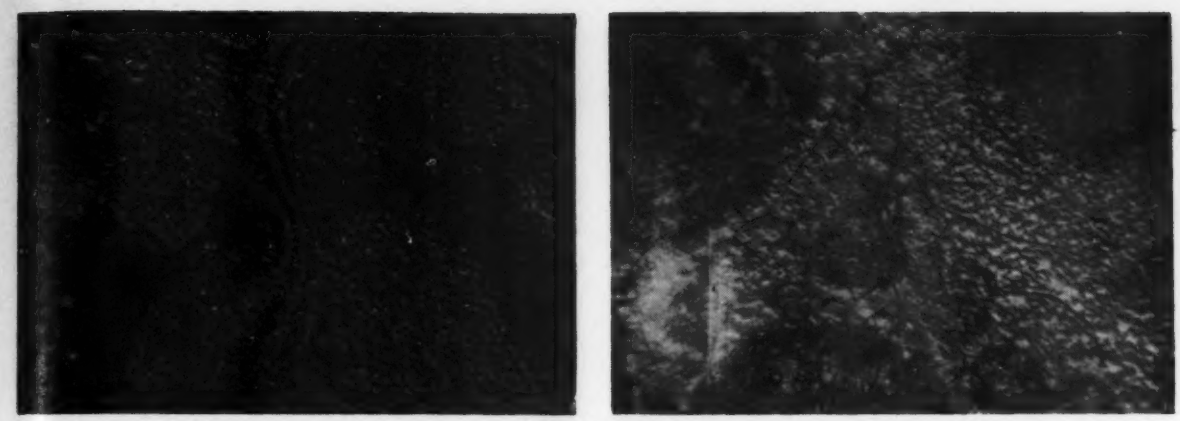

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FIG. 3. Advanced stages of scum showing scaly, mosaic type deposits with highly developed surface cracks.

Deterioration by Moisture

by Frank Moser

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as a permanent deterioration of the surface unless the stained area is ground and polished.

Usually scum formation is a prerequisite for staining and occurs under a variety of conditions normally encountered in service. Our concern was to study the scumming and staining of glass surfaces in order to find suitable means for maintaining a clean glass surface.

II. Experimental Procedure

Scum and stain development on glass surfaces was obtained under cyclic-humidity exposures. Apparatus for accelerating scumming and staining of glass was constructed similar to the testing cabinets designed by Simpson (2). In this method, small pieces of glass (3x3 inch) are exposed in Pyrex humidity cells that are fitted with notched racks to hold the glass specimens in an upright position so that the air within the cell can be circulated around each specimen by a continuously moving stainless steel bladed fan. Cell and oven temperatures are held between 48° and 58°C. A cam-timer arrangement is provided for controlling alternate drying and fogging periods within the cell.

Sample Preparation

Specimens were cut at the factory from large glass plates that were selected for uniform quality. Plates 12 x 24 inches in size were further cut into 3 x 3 inch specimens for scum and stain testing. The uniform cleaning procedure that was used for preparing the glass before exposure consisted of rubbing the surface with

FIG. 4. Scum development by droplet condensation.
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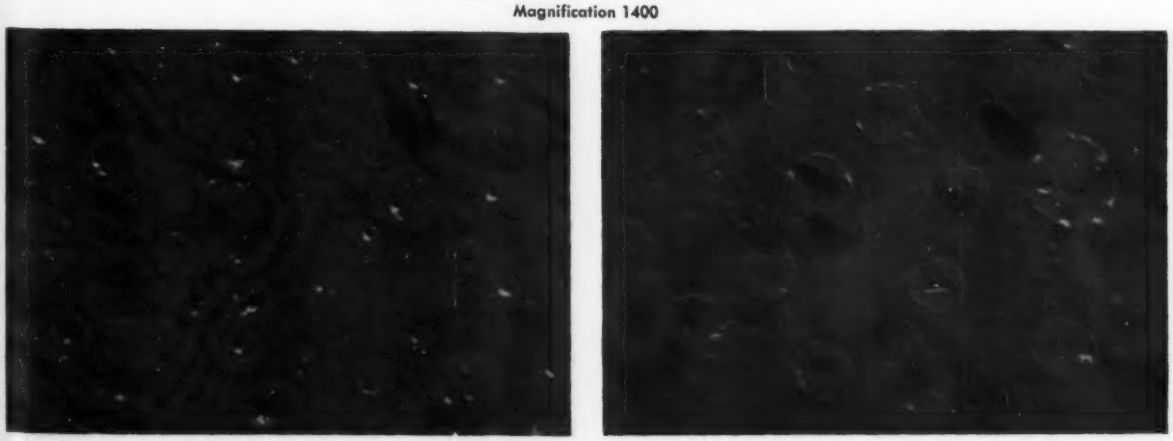

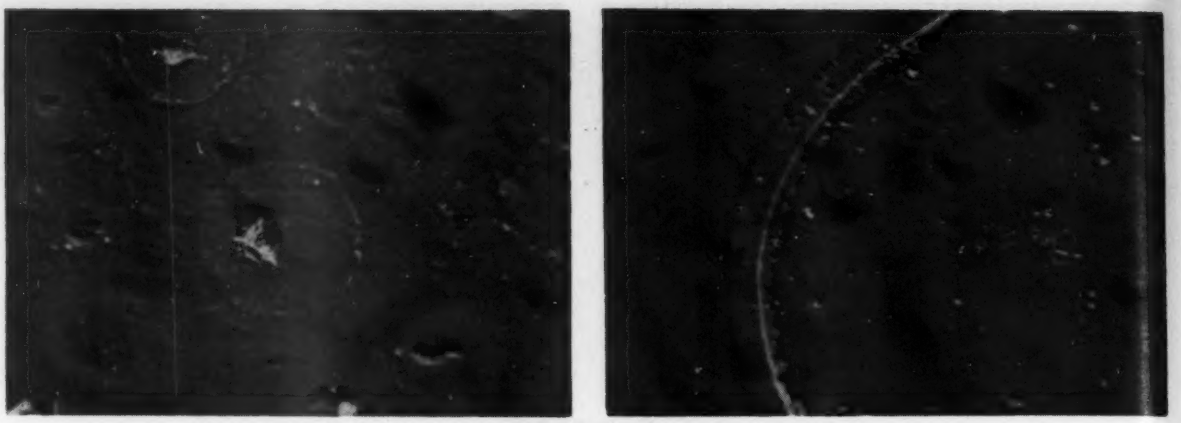

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FIG. 5. As condensation continues the droplets enlarge with some pitting action initiating.

a slurry of calcium carbonate on a cotton swab, rinsing with distilled water, and drying with a filtered air blast. The glass samples were held with platinum tipped tongs during the rinsing, drying operations and placement in the cells for exposure in order to prevent any contamination from handling.

Photomicrographic Techniques

An American Optical "Phasestar" Microscope equipped with a trinocular body and a 35-mm camera was used for examining and photographing the scum and the stain on the glass surfaces. Photomicrographs were taken to show the structural development of scum, and rate of formation was obtained by means of a series of photographs which include the initial surface and the identical area during various stages of cyclic-exposure.

A Zeiss interference microscope (research model) equipped with a 35-mm camera was used for photographing the magnitude of scum and stain. A differentiation between scum and stain on glass surfaces is obtained with the aid of a scribed reference mark that was placed on the initial clean glass surface. The Zeiss interference microscope measures the depth of scum or stain by deviations of the wave bands. Accumulations on the glass surface will give a deviation in the opposite direction to that produced by the scribed mark; an etching into the surface is shown by a deviation in the same direction as the scribed mark. Interferograms of the various exposed glass are used for demonstrating scum and stain development.

III. Discussions of Scum and Stain Studies

Several types of reaction cause scum to initiate on glass surfaces. Explanations of such activity attribute it to hydration at preferential adsorption sites and to subsequent chemical action. Scum development on glass that was exposed to cyclic-humidity for an extended period is shown by a series of phase contrast photomicrographs. In Fig. 1, the illustrations show an initial clean polished plate glass surface and scum after a brief exposure to cyclic-humidity. Apparently in this type of scumming, moisture collects at random sites and as

FIG. 6. During later stages pitting action becomes more severe along with heavy scumming.
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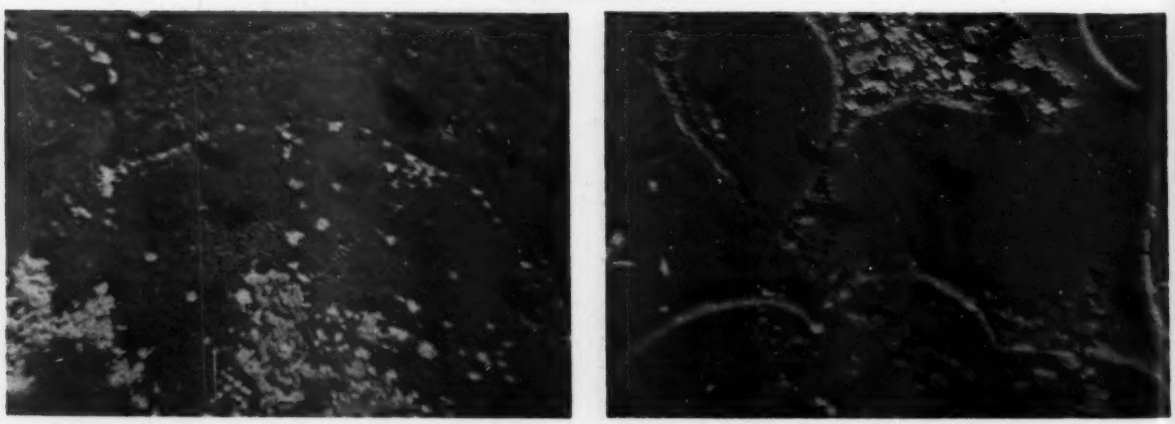

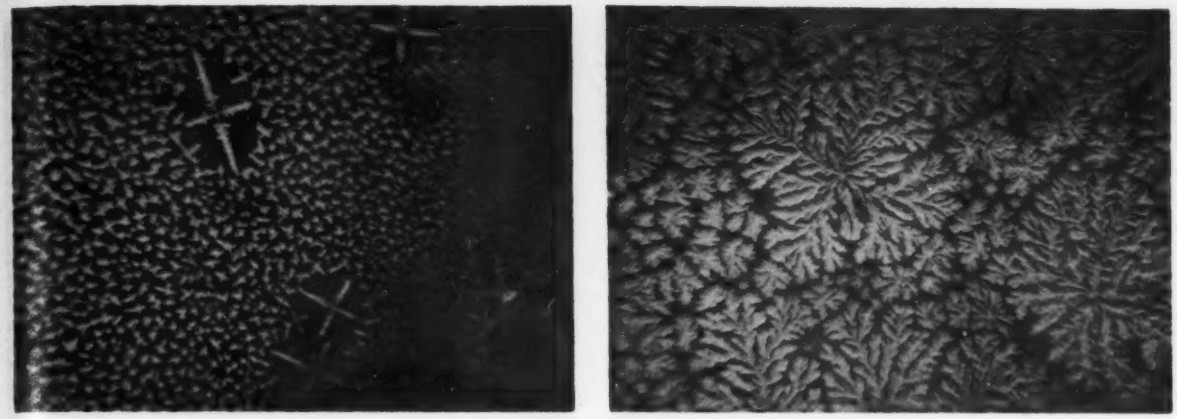

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FIG. 7. Dendrite type crystal formation on glass.

the attack continues, the moisture spreads over the surface and forms films. By this time the condensation film has certain solvent effects and combines with the alkali that has migrated to the surface from the silicon-oxygen network. In Fig. 2, scumming has progressed to a stage where the deterioration of the surface is quite evident as shown by the formation of heavy accumulations.

As scumming continues, consolidation of the smaller areas into larger scattered frosty deposits occurs over the entire glass surface. In the advanced stages of scum formation (Fig. 3) heavy mosaic deposits are visible, while on other parts of the glass surface, the flaking and the development of an orthogonal system of cracks are very pronounced. This type of surface reaction is characteristic of the soda-lime glasses, including both polished plate glass and sheet glass. Sheet glass is more resistant than plate glass and requires extended periods of exposure for scum and stain to develop. After the initial attack and scum deposition, the further staining of a sheet glass surface proceeds with speed comparable to plate. Also, if the sheet glass surface is polished, scum and stain develop at a rate comparable with that of plate.

A droplet condensation mechanism for scum propagation is shown in Fig. 4, 5, and 6. Small droplets of moisture (Fig. 4) collect on the glass surface at random sites. As these drops continue to enlarge (Fig. 5), an increasing solute concentration is built up within the droplet by dissolving the silica and alkali constituents of the glass. As a result either the surface is pitted or siliceous materials precipitate as shown in Fig. 6. Pitting appears to be active at the boundaries of the droplet as the increased content of solute causes the droplet to act as an etching agent. Also, excess solutes precipitate as complex silicates and alkali carbonates.

Scum may appear as crystalline structures. Dendrites, fibrous bundles, laths and wedge-type structures have been observed. Even prism-like crystals, typical of some carbonates, have been identified. Oberlies[3] has indicated the presence of $CaCO_3$ crystals on hydrolytically attacked glass surfaces, while Tsuchihashi[4] shows that surface reactions may deposit alkali compounds either as hy-

FIG. 8. Fibrous and lath-like crystals on moisture-vapor attacked glass surfaces.
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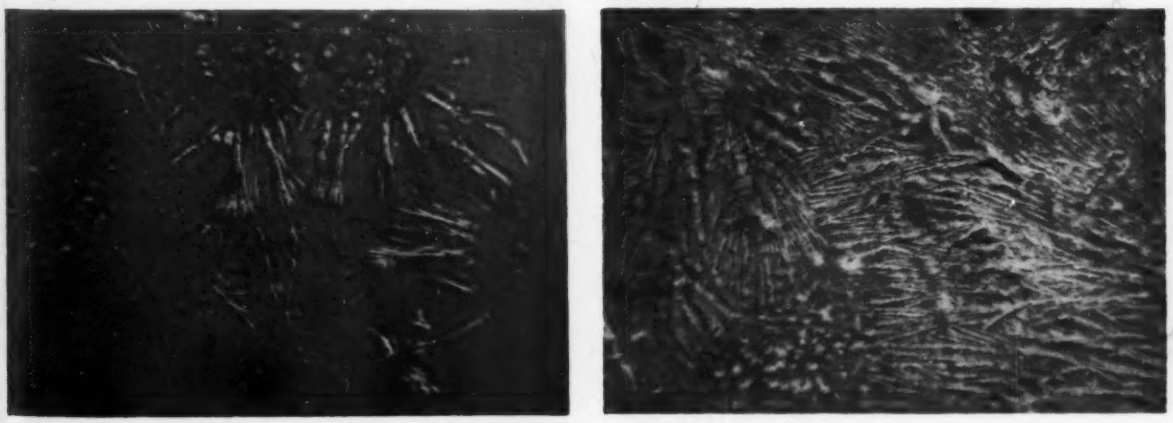

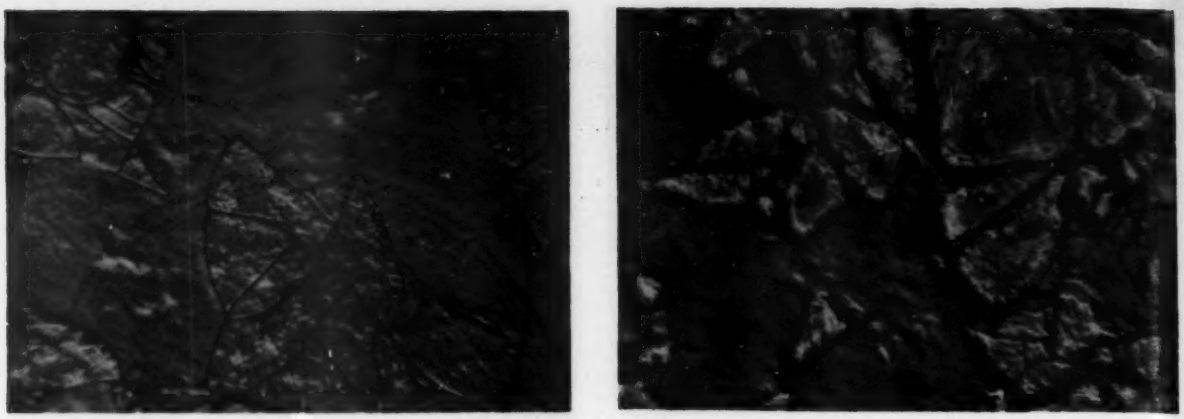

Magnification 1400
FIG. 9. Glass in advanced stages of staining.

droxides, carbonates, chlorides, or sulfates which may be developed from the various gases that are present in the surrounding atmosphere during moisture-vapor attack.

Crystalline growths that are found on exposed glasses and shown in Fig. 7 and 8. The dendrite type first becomes visible as a very small 90° angle crystal and continues to branch until surface areas are completely covered. However, the crystalline material appears to be an accumulation since pumice and water cleaning removes the crystalline pattern leaving only shallow pits where the dendrites fanned out from a preferential site. Likewise in Fig. 8, the growth of the fibrous-bundle type crystal is illustrated. The initial growth starts in the form of a branching arrangement, while in more advanced stages, completely formed needle-like crystals appear either as bundles or as the lath-like type. Identification of the chemical constituents of the crystals was attempted by qualitative emission spectrographic analyses, by spot tests, and by X-ray diffraction. These exploratory analyses gave little information except that certain chemical constituents such as Si, Na, Ca, Mg and Fe were present, while the presence of $Al_2O_3 \cdot SiO_2$ was indicated. Also, examinations of heavily stained polished plate glass (Fig. 9) by infrared reflection techniques showed that a thin SiO_2-rich layer may be present on stained glass surfaces. Such deduction may be made

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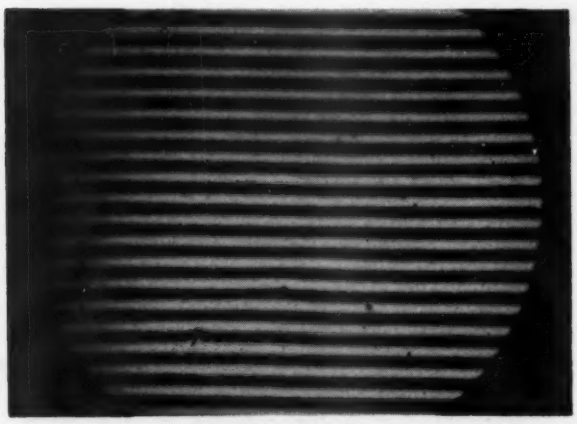

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FIG. 10a. Initial glass surface.

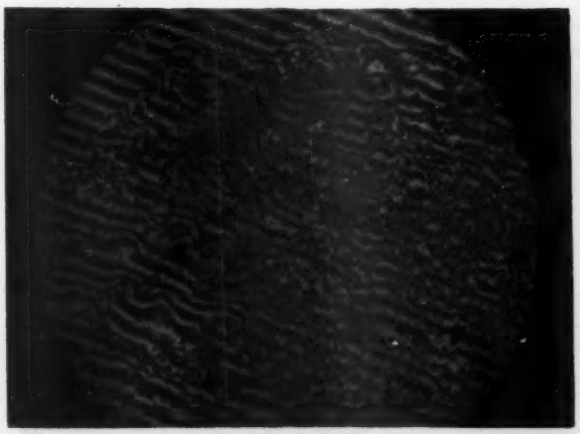

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FIG. 10b. Glass surface with heavy scum.

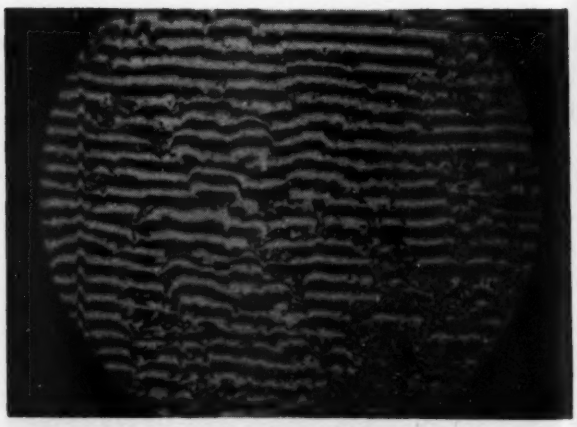

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FIG. 10c. Same surface as 10b, after pumice cleaning.

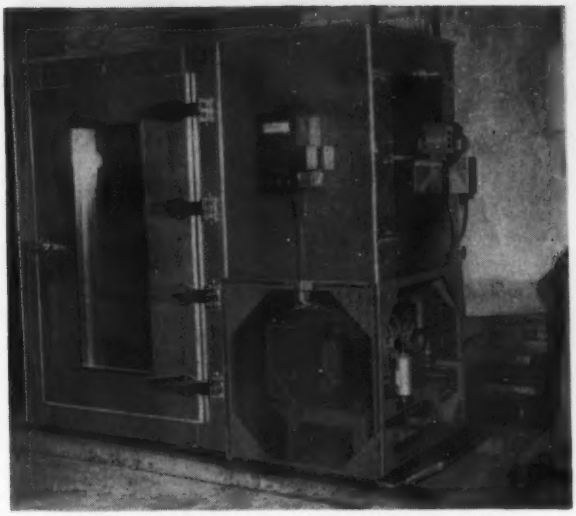

Fig. 1. Cabinet for thermoshock and thermocycling.

Mirror Backing

THE APPLICATION OF BACKING PAINTS

by ***R. H. Turner,*** President, Falconer Plate Glass Corp., Falconer, New York

● LIKE THE MIRROR TRADE IN GENERAL, we have progressively tried to produce a more durable mirror: one which is more resistant to atmospheric corrosion, one which can be shipped and handled with less risk of damage, and can be easily and economically produced at a uniformly high level of quality.

To be durable, a mirror must have the correct protective backing material, which is very important, and this must be applied properly.

Much has been said about covering the thin silver film of the mirror with various applications of copper. The accidental discovery of the deposition of reflective silver from an ammoniacal solution of silver nitrate by Von Liebig in 1835 posed the problem of protecting the reflective film, subject as it was to mechanical damage and corrosion from atmospheric fumes.

The previously used mercury and tin amalgam films did not need such protection. It is strange how many people today think that mercury is the reflective medium, not knowing that such production is outlawed, while silver affords the best reflection in the visible spectrum that we have yet been able to produce.

Von Liebig suggested the electro deposition of a heavy copper backing; however, few mirrors were produced with this method since it was too expensive, and plating techniques and equipment in the mid-nineteenth century were rudimentary.

Someone once found that shellac would do an acceptable job of protecting the silver film. It was cheap, dried fast and had excellent adhesion to silver. As a result, it was used extensively for more than one-hundred years over silver, and later over copper-plated silver. A few mirror manufacturers still use it today.

Because shellac is brittle and had to be applied in thin films, a white lead paint was often applied over the shellac to provide better protection. The first white lead paints were probably simple white lead in oil; however, the need for faster drying led to the replacement of the oil vehicle with Japans.

Mirror production increased greatly in the 1920's after World War I, particularly in the larger sizes. The demand for better backings has also increased since that time when the earlier mirrors were used principally in frames for furniture. Today they appear in all manner of installations.

Since World War II, mirror production has become more automated, and the mirror manufacturer today must cope with demand for fast drying on continuous conveyorized lines at relatively high speeds. The ideal is to pack and ship the mirrors immediately after taking them from the line, following cleaning and inspection.

The increased production capacity of plate glass manufacturers has enabled mirror makers to increase their capacity beyond current demands.

This has led to stock sheet mirrors, a big factor in the quick availability of mirror from the large,

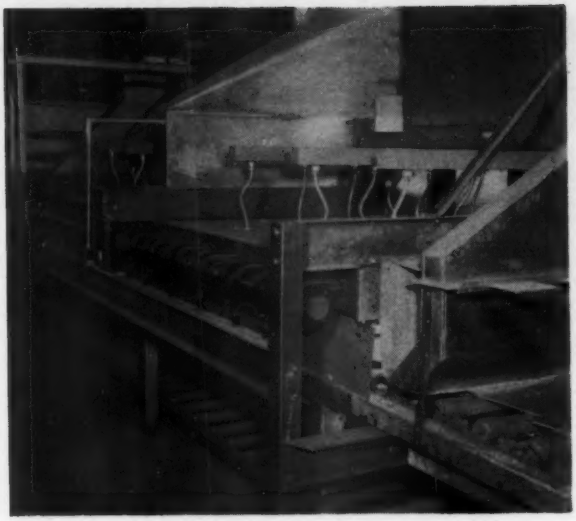

Fig. 2. Infra-red oven with quartz lamps on mirror line.

and smaller shops. Not only does the mirror have to have excellent protection against atmospheric corrosion, but it must also have a hard backing which is resistant to mechanical abrasion. The mirror must be of such high quality that it can be cut to smaller sizes without flaking around the edges and can be fabricated with edgework, hole drilling and sand blasting. It must be resistant to peeling, resistant to coolants and lubricants used in the fabricating processes, and above all, it must be capable of being stored without danger of deterioration.

These requirements posed a problem to the mirror maker, and the backing manufacturer as well, owing to the seemingly opposing limitations involved. The silver film itself must be thick enough for durability; yet, if too thick, the cost is excessive, and adhesion suffers. Our company has for many years been an advocate of a film of copper-electro plated to the silver film which we call "genuine electro-copper plated," since it is applied with external voltage, an electrolyte and anodes.

We have found that such a coating must be of proper thickness. If too thick, the coating will peel off in large sheets, should the edges be disturbed. If too thin, there is not adequate protection. The silver film of commercial mirrors being in the range of three to six millionths of an inch in thickness, and copper about half of these figures, this is understandably so. Therefore, metallic copper itself cannot be a complete answer.

For some years, we have been trying to arrive at an accelerated test for durability of a mirror under normal use conditions. The standard has been a salt spray test, formerly of 4 per cent at 70°F. Lately, the temperature has been increased to 95°F and in some instances, the concentration to 5 per cent. This treatment, applied continuously or intermittently, so as to be proportional to useful life, is open to some question, but at least it gives a basis of comparison for different types of backing.

The paint systems using shellac or shellac-type primers and relatively slow oxidizing topcoats have performed well for many years, whether over silver itself, or over different types of copper coatings.

Such wide discrepancies under test were reported with these paints and this method of application that it was attempted to determine the relative value of the various coatings. Under salt spray a silver film alone would spoil in a few hours, while an electro-copper plated silver coating would last from five to ten times as long. Using the paints described above, such combinations would usually pass 100 hours of salt spray, perform fairly well in cutting, and meet the modest requirement for drying involved in most conveyorized mirror lines at that time. All in all, a fairly good mirror resulted.

Paint research on mirror-back coatings for the first time in many years challenged the old type shellac primer—slow-dry, top-coat systems—and explored the possibilities of new-type coatings. At the same time, up-grading the protection properties was investigated, and a goal of at least 500-hour salt spray became a possibility.

At any time, it seemed possible to build up a thickness of paint to withstand a salt spray test of any reasonable length of time, but at the sacrifice of almost all the other desirable qualities. To investigate these qualities, a thermocycle and thermoshock test has been devised, using equipment which will, within a short space of time, alternately change the temperature of samples from —40°F to 160°F and reverse. Such a thermocycling cabinet operating automatically is illustrated in Fig. 1.

It was thought that such a procedure, repeated many times, would be an accelerated test of ageing and, in conjunction with salt spray and hardness tests, would truly determine the fitness of a backing to withstand handling, atmospheric corrosion, cutting, fabrication, and ageing. That some of the former backings came off in sheets under such testing seemed to indicate another approach to paint formulation.

With better backing equipment and greater heat capacity now available to the mirror industry, it was evident that the newer types of backing could be used, which would give film toughness, without pulling, along with other very important factors of general protection qualities, adhesion and flexibility to withstand fabrication, hardness, and retention of these properties over long storage periods.

These properties have all been built in to a "single-coat" high-temperature system which now replaces the old two-coat system and allows for faster production schedules, faster handling, and better mirror protection than was previously possible.

This combination in our development of it, consists of the use of Pittsburgh Plate Glass Company's Hi-Bake synthetic resin coating applied by Nordson airless paint

spray system; one of the units can be seen in Fig. 2. Two spray oscillators with guns 3½ feet apart are used, each with its separate paint supply and separate unit. The two units tend to even the coating and give assurance of complete coverage. Both guns operate in one booth. A soft air blast flashes off excess volatile matter immediately after the spray booth. At least two and one-half minutes is required for the flash off.

Since the thickness of paint coating is a function of speed of conveyor, size of nozzle, viscosity of paint, and the temperature and pressure at the nozzle, these must be standardized. For a thickness of seven to eight grams per square foot dry coating (about four to five mils wet) each gun delivering 5.4 gallons per hour a viscosity of seventeen seconds using a #2 Zahn cup at room temperature is required for the following conditions: temperature at nozzle 140°F, pressure at nozzle 600# per square inch, speed of conveyor at 56 inches per minute. The glass is preheated to about 110°F surface temperature. A variation of any one of the conditions requires appropriate adjustment in the others.

Fig. 2 shows the mirror silvered and copper plated with a spectral finish. It is face down ready for spraying on the upper surface which is the back of the mirror. A slat conveyor is used, the steel bars being covered with asbestos cloth. A cable conveyor might better be used, as the cables are easily cleaned during continuous operation.

Along with this absolute and continuous control of the thickness of films, it is most important to keep the films uniform and to have continuous control of temperature and time of baking in order to maintain a uniformly good mirror.

The quartz lamp infra red baking oven (Fig. 3) consists of fifty-four units of two 1600 watt quartz tubes, each with gold-plated reflectors by Fostoria. The oven is on a time cycling arrangement to control temperatures. The baking temperature is just under 350° at maximum, held there for at least one minute. The baking continues with a steadying increase in temperature for at least 2½ minutes and is cooled slowly to room temperature. About 8 to 10 minutes is required for this cooling in a draft-free room before the mirrors can be handled. Under cool room temperatures, a soft air blast slightly heated is required to prevent breakage.

It is possible to maintain this uniformity in mirror quality only under supervised continuous production. It is not possible if the mirror is produced separately.

One cannot refrain from mentioning the marketing aspects of an improved product. The writer has in his home mirrors made over thirty-five years ago which show no deterioration. On the other hand, especially in some older public buildings, it is hard to find a mirror which does not have some silver spoilage, in instances some as bad as to almost preclude the use of the mirror. It must be concluded that the rehabilitation of these installations would represent an enormous outlay and a good market for some one.

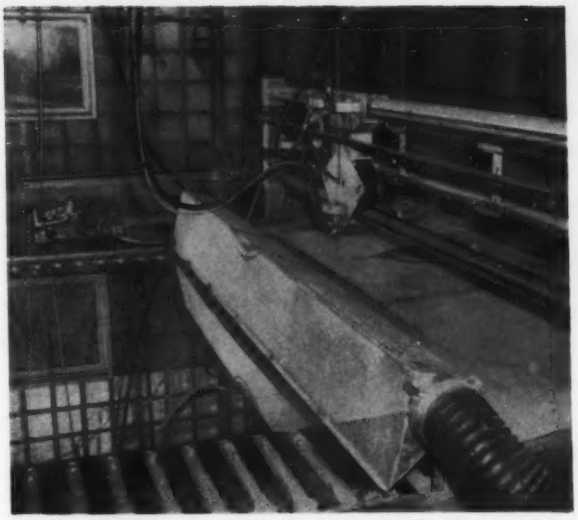

Fig. 3. Forward side of spray booth with Nordson equipment in back.

Our company kept a record over a long period, insisting upon return of all rejections during this time, and came to the conclusion that far less than half of the complaints are the fault of the manufacturing. Most complaints stemmed from mechanical damage and defects in the glass; the rest were unjustifiable.

It would seem then that a claim made for a defective mirror long after manufacture would indicate that the mirror was defective when received, and rejected only on later inspection.

The advent of commercial production of the electro-copper plated mirror, and its substitutes, brought about a plethora of guarantees in the early thirties. Because of their very ridiculousness, the time limit was subsequently reduced to a one-year guarantee for an ordinary mirror and a five-year guarantee for an electro-copper plated mirror, for which at that time it was necessary to obtain a high price.

It is hoped that these new improvements do not bring about a further rash of statements and claims, each exceeding the last. It would seem that, if a mirror can be guaranteed to pass tests for the desirable qualities as outlined above, then the one-year guarantee recommended by the National Association of Mirror Manufacturers would be sufficient. A mirror made under the conditions described, if in perfect condition at the end of a year, should last indefinitely.

Acknowledgment

I am indebted to Rowland S. Hartzell, Technical Director of the Springdale Paint Division of Pittsburgh Plate Glass Corporation, and J. G. Seger, Works Manager of Falconer Plate Glass Corporation, for some of the observations made.

FIG. 1

FIG. 2

How to Select Hoppers for Glass Plant Use

● SELF-DUMPING HOPPERS are one of the simplest tools used in materials handling, but they can be ineffective if selected haphazardly. The best standard hoppers are made of 3/16-in. steel plate to withstand the abuse of heavy loads and rough handling; however, this construction should be modified if the operation requires it. For example, when a highly abrasive material such as cullet is handled, manganese steel bottoms will protect hoppers from excessive wear. Zinc-coated or stainless steel hoppers should be considered for handling materials detrimental to paint or contaminated by rust.

Hoppers used for handling hot materials, cullet, gobs and furnace skimmings (Fig. 1) are often reinforced with extra heavy steel to prevent warping. And where hot materials are emptied into hoppers without pre-cooling, tapered sides are used to avoid "freezing." Self-dumping hoppers for cooling waste materials in glass plants should have water-tight seams; drain cocks can be fitted to empty the water before waste glass is delivered to the cullet crusher.

According to Roura Iron Works, Inc., Detroit, the following factors should be considered when buying self-dumping hoppers for handling jobs in glass plants:

1. Hopper capacity.
2. Type of dumping action.
3. Hopper mountings.
4. Storage facilities.

Hopper Capacity

Although standard size hoppers are adequate for most

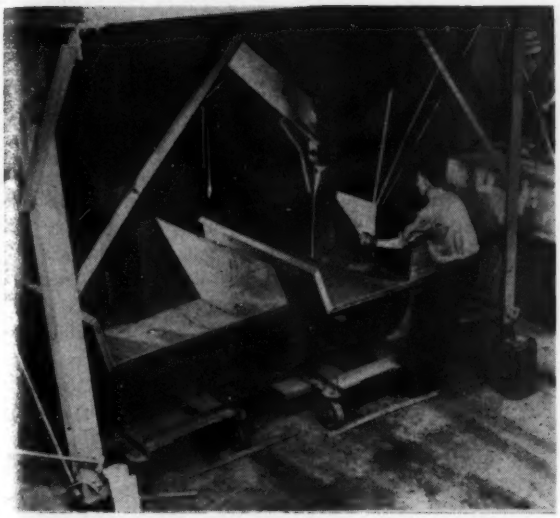

FIG. 3

FIG. 4

glass-making operations, special sizes can be obtained. Hoppers with capacities of four cubic yards or more are available for large-volume applications, and there is a narrow-aisle hopper 30-in. wide, particularly suited for use in cramped spaces.

The kind of material handled isn't as critical as the handling cycle: where hoppers are emptied frequently, even though they are not full, a smaller, lighter model is the best choice; where hoppers are emptied only when full, order larger sizes to reduce the number of handlings.

Whenever fork or hand trucks are used to move hoppers, the truck capacity should be considered. The combined weight of a big hopper and its contents may exceed the truck's load limit. Table I is a guide to the approximate weights of standard-size hoppers.

Table I

STANDARD HOPPER WEIGHTS

Hopper Capacity (cubic yards)	Approximate Empty Weight (pounds)
½	500
¾	625
1	660
1½	825
2	900

Dumping Action

Two kinds of dumping action can be specified—balanced or controlled. The balanced hopper is the only really self-dumping hopper. When a lock-handle on the rear is released, the hopper tilts forward to dump (Fig. 2). Then it returns to an upright position, locking automatically. Most common in use, balanced hoppers are correct for the majority of bulk-handling operations in the glass industry.

If controlled or slow dumping is required, a pulley-and-winch arrangement replaces the lock handle; the hopper can be tilted or returned at will. Controlled dumping is practical for feeding free-flowing bulk materials directly onto an oscillating or moving conveyor belt.

Hopper Mountings

Caster mountings are advantageous where hoppers must be moved manually (Fig. 3) or towed by a tractor. For special applications rubber tire or plastic casters can be obtained. But under rough use, malleable iron casters will last much longer than ordinary casters. Money can be saved by specifying skid-mounting if casters are not required.

While most hoppers are lifted and carried from the rear, a special three-way entry skid-mounting can be obtained which allows pick-up from the rear or either side. Side entry is advantageous when hoppers are stationed in crowded locations. Also, combination mountings are available which permit entry by either platform or fork trucks.

Storage

For plants where storage space is at a premium, hoppers are equipped with special flanges which permit stacking (Fig. 4); loaded hoppers can be tiered, if contents are level. Because their contents can be emptied in a few seconds, self-dumping hoppers are very practical for "live" storage of bulk materials.

Bibliography on Glass Structure*

PART XI

286. G. J. Dienes

"Activation Energy for Viscous Flow and Short-Range Order," (Brookhaven Natl. Lab., Upton, N.R.), J. Appl. Phys. 24, 779-82 (1953).

Viscosity-temperature properties of many systems are characterized by highly temperature-dependent activation energies for viscous flow. It is generally recognized that structural changes taking place in the material as a function of temperature are responsible for this phenomenon. A formulation of viscosity-temperature relations is presented in which the structural changes are explicitly taken into account by means of the formalism of short-range order as a function of temperature. The resulting equation is shown to be a generalization of several semi-empirical equations in current use. The equation was applied to several glasses, high polymers, and water, and was found to describe the experimental viscosity data with high accuracy over a wide temperature range.

287. Milota Fanderlik

"Transformation Rate and Constitution of Glass," (Glass Research Inst., Czech.). Proc. XIth Intern. Congr. Pure Appl. Chem. London 5, 441-6 (1947). (Pub. 1953).

The transformation and annealing rate of glass during tempering were studied by a freezing method; the change of the n of the He D line was used as an indicator for the transformation. The n of the β state, stable at high temperatures, was determined by quenching from successively higher temperatures until a constant minimum value was reached $n\beta = 1.51798$. The index of the α state, stable below the transformation region, was reached by tempering at the lowest possible temperature (329°) for 1200 hrs. and extrapolating to constancy. The value found was $n\alpha = 1.51910$. It was assumed that the transformation of glass follows the equation of a second-order reaction, except during the initial period. The reaction being a true equil., its constant can be determined from the transformation reaction rate constants k_1 and k_2 in the directions $\alpha \rightarrow \beta$ and $\beta \rightarrow \alpha$. However, calculation of the constants shows a difference in the rates of the two reactions, which can be explained only by assuming that the transformation in the $\alpha \rightarrow \beta$ direction is complicated by an unknown phenomenon which must be studied separately.

288. Joh E. Hiller

"Degrees of Order in the Structure of Crystalline Solids," Naturw. Rundschau 6, 49-53 (1953).

The constitution of gases (as ideally isotropic and disordered material) and of liquids (as incompletely disordered, partially ordered, and distinctly ordered groups as (SiO_4) in silicate melts) is contrasted with that of the crystalline state. Between liquids and crystals, the "amorphous" materials are characterized by a distinct degree of order in at. distances, and distinct nos. of particles occuring in these distances. The stability of these groups in amorphous materials indicates an intermediate, "pre-cryst." constitution, e.g. Their chief distinction from crystals is the absence of a symmetry principle governing the structure although the binding mechanism and the general chem. aspects are the same as in crystals, and crystallochem. laws are valid also for glasses. "Amorphous modifications" of one and the same substance may therefore exist; from quasicryst. configurations continuous transition is observed to different steps of apposition-periodicities, to quasicryst. micellar structures, mol. and layer structures, etc., to the coordination crystals. Isotropic atoms, or at. and ionic groups like (SiO_4) and similar configurations, are continuously related to glasses (quasi-cryst.), chain structures (in pyroxenes), layer structures (in micas), the 3-dimensional framework coordination lattices (e.g. in quartz). Similar series are demonstrated for inorganic and organic compounds (e.g. rubber, cellulose, β-keratin). The particular character of cryst. solutions (mixed crystals), and other crystals of statistically disordered structures is extremely frequent in silicates, and some compounds with "variable equipoints," e.g. Li_2FeO_4 ("inner crysts. solns."), and the superstructures of alloys, like CuAu, Fe_3Al, PdCu, etc. A 2nd disorder principle is given by the theory of flaws and empty positions in coordination structures, with not strictly stoichiometric at. ratios (type FeS, CoS, ν-Fe_2O_3, FeO). In most cases, the cations are defectively ordered, the anions intact in their positions (type Ce_2S_3, Co_3S_4); in CoTe the intermediate metal layers are continuously reduced until they have entirely disappeared, and the CdI_2-layer structure type of $CoTe_3$ results. Wandering cations (by "inner fusion") are well-known from α AgI and Ag_2HgI_4. Transitions from ordered to configurations of lower order are observed in RNO_3 compounds with rotating groups (NO_3), which become increasingly frequent in the temperature range from 150 to 275°.

289. E. Kordes, W. Vogel, and Ruth Feterowsky

"Physical Chemical Investigations of the Characteristics and Fine Structures of Phosphate Glasses," Elektrochem. 57, 282-9 (1953); C. A. 47 10945 (1953).

A thorough investigation of the effect of additives to phosphate glasses was made by measuring the n over a wide variety of compositions. The values of the ns, Abbe nos., and mole refractions were plotted against the mole fraction of the components. If the resulting curves were smooth, the mixtures were called normal,

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whereas those that showed sharp breaks were attributed to abnormal mixture. Normal mixed phosphate glasses were formed from systems of P_2O_5 with BaO, CaO, CdO, and PbO and would be expected for the mixture of P_2O_5 with any basic oxide. The obnormal systems were formed when P_2O_5 was mixed with ZnO, MgO, or BeO. These abnormal mixtures showed very sharp breaks in the curves of the Abbe no., and mole refraction at compositions corresponding to 50-50 mixture. An explanation of this behavior was based on the schematic structure of a P_2O_5 glass as first presented by E. Kordes. If the more acidic oxide exceeds 50 mole %, then the available O bonds are fully utilized and the coordination number changes from 4 to 6 or more. The crystal structure, which was initially in the shape of a tetrahedron around the P atom, is changed; this change in turn produces a sharp change in the properties of the glass. For basic oxides, which show normal behavior, it is still possible to retain the tetrahedron crystal structure. Other systems that should show normal behavior are P_2O_5 mixed with NaO or Li_2O. It is claimed (though no data are given) that similar trends are found in the mol. vol., d., and hardness. Several schematic structures are shown.

290. Ivan Simon

"Structures of Silicon Dioxide and Boric Oxide Glasses Compacted by Very High Pressures," Phys. Rev. 90, 350 (1953).

291. J. M. Stevels

"Graphical Statistical Analysis of Glass (Part II)," Verres et Refrac., 7, 281-286 (1953).

The author shows that, for glasses in the system Na_2O-CaO-SiO_2, there exists a linear relationship between the specific refraction S and the dispersion D of the type:

$$S = DX \text{ constant} + f(R)$$

where $S = \frac{n_D^2 - 1}{n_D^2 + 2} \cdot \frac{1}{P}$, $D = n_F - n_C$ and f(R) is some function of R, which is the ratio of the number of O ions to the number of Si ions, and which is therefore independent of the content of Na and Ca ions. It thus becomes possible, knowing qualitatively that only the above ions are present, to determine from the simple measurement of S and D the proportion of bonding and non-bonding oxygen ions. A theoretical basis for the foundation of this relationship is discussed from the point of view of the ionic factors for dispersion and refraction derived by Huggins and co-workers.

292. A. A. Appen

"Coordination Structure of Silicate Glasses," Steklo i Keram., 11 (3) 7-9 (1954).

Results of physicochemical studies of the properties of glasses confirm the theories that recognize the existence in glass of a continuous silicon-oxygen skeleton and the possibility of the replacement of silicon in the structural lattice of glass, under proper conditions, by the ions Al^{3+}, B^{3+}, Ge^{4+}, probably Ti^{4+}, and certain others. The most important structural factors which exert a decisive influence on the characteristics of glass are the extent of cohesion of the silicon-oxygen skeleton, as determined by the ratio of the number of oxygen ions to the number of silicon ions in the coordination state of the cations. The existence of a nonregulated cation (Si^{4+}, Al^{3+}, B^{3+}, etc.)-oxygen skeleton and the coordination principle of the distribution of ions (atoms) are the two typical and most important characteristics of the atomic structure of glass. The skeleton-coordination theory does not in the least deny the possibility of the differentiation of components and the formation in glass of crystallites and/or amorphous regions of a different composition.

293. Clarence L. Babcock, Stephen W. Barber, and Kasimir Fajans

"Coexisting Structures in Vitreous Silica," Ind. Eng. Chem., 46 (1) 161-66 (1954).

The unusual behavior of vitreous silica indicates that its structure may involve two or more distinctly different atomic arrangements coexisting in a homogeneous equilibrium in ratios that vary with temperature and pressure. The very small expansion coefficient can be explained if, under given conditions, the "structures" dominant at low temperatures have a larger volume than the others. The exceptional behavior of both the compressibility and the elastic properties of the glass are consistent with this assumption. Low temperature heat capacity, as well as infrared and Raman spectra, indicates the coexistency of relatively weak and strong forces, of large and small vibrating masses, or both. The fact that the unusual behavior of vitreous silica is observable during measurements at moderate temperatures shows that the assumed mutual conversions of the coexisting structures are rapid and reversible. Besides these structures, it is necessary to distinguish various relatively stable "states" which the glass assumes depending on thermal history. Knowledge of the structure of glass, especially of atomic positions, should promote its widespread use as an engineering material. 38 references, 7 figures.

294. J. O'M. Bockris and D. C. Lowe

"Viscosity and Structure of Molten Silicates," Proc. Roy. Soc. (London) A226, 423-35 (1954).

A new type of rotating-crucible viscometer is described. Viscosities can be measured for liquids up to 1850°. Measurements are reported for the system CaO-SiO_2 over the composition range 30 to 58 mole % CaO. Newtonian flow was found and the viscosity isotherms as a function of composition did not show an inflection. Activation energies are discussed. The high viscosity and the activation energy for flow in SiO_2 indicate that only a small fraction of the melt exists at any instant in the form of SiO_2 mols. so that those SiO_2 mols. that take part in the flow process must be formed from the three-dimensionally bonded lattice. The only type of structure consistent with the observed behavior is one containing discrete silicate ions. Discrete-ion structure is discussed and a model is proposed.

295. Adolf Dietzel, Helmut Wickert, and Nina Koppen

"The Ternary System Li_2O-BaO-SiO_2," Glastech. Ber. 27, 147-51 (1954).

On the basis of the ratio z/a^2 (z the valence of a given cation, a the distance of cation to O^{--}) as a measure of the strength of binding (field strength), Dietzel has given previously (C.A. *37*, 12[9]; *45*, 5890d) general rules for the formation of binary and ternary compounds in silicate systems. He predicted that, because of the similarity of the z/a^2-values for Li^+ and Ba^{++}, in the system Li_2O-BaO-SiO_2 no ternary compounds must be expected. The investigation of this system by the authors (using the quenching method, combined with microscopic examinations of the cryst. phases) entirely confirms this conclusion of D. Only the binary silicates of the partial systems Li_2SiO_3-SiO_2, Li_2SiO_3-$BaSiO_3$, and $BaSi-O_3$-SiO_2 are identified. Particularly interesting is the rather large field of primary crystn. of the cryst. solutions of $BaO{\cdot}2SiO_2$ and $2BaO{\cdot}3SiO_2$, and the narrow field for primary $Li_2O{\cdot}2SiO_2$. Experimental difficulties arose from the volatility of Li_2O from the melts, and the hygroscopicity and CO_2 absorption in the ternary glasses. Careful analytical control was indispensable. Among the cryst. phases which all have a normal character, the prompt crystallization of tridymite, and not of metastable cristobalite, is remarkable. Evidently, the presence o Li^+ is in favor of the establishment of the phase equil. The invariant points (all eutectics) are the following: (1) in the binary partial system $Li_2O{\cdot}SiO_2$-$BaO{\cdot}SiO_2$: 970°, with 50.0% SiO_2, 26.0% BaO, 24.0% Li_2O; (2) in the pseudo-binary system $Li_2O{\cdot}2SiO_2$-$BaO{\cdot}2SiO_2$: 960°, with 66.5% SiO_2, 12.0% BaO, 21.5% Li_2O; (3) in the ternary partial system $Li_2O{\cdot}SiO_2$-$BaO{\cdot}SiO_2$-$2BaO{\cdot}3SiO_2$: 940°, with 53.0% SiO_2, 24.5% BaO, 22.5% Li_2O; (4) in the ternary partial system $Li_2O{\cdot}SiO_2$-$Li_2O{\cdot}2SiO_2$-$BaO{\cdot}2SiO_2$: 910°, with 65.5% SiO_2, 12.5% BaO, 22.0% Li_2O; (5) in the ternary partial system $Li_2O{\cdot}SiO_2$-$BaO{\cdot}2SiO_2$-tridymite: 920°, with 67.0% SiO_2, 12.0% BaO, 21.0% Li_2O.

296. O. A. Esin and P. V. Gel'd

"Structure of Glasses and Properties of Molten Silicates," Steklo i Keram. 11 (3) 4-6 (1954).

Extensive experiments were made by various authors to confirm the view that structurally the vitreous state is intermediate between the crystalline and liquid states. The authors develop a picture of the ionic nature of many glasses, assuming that basically the same particles are retained in the vitreous state as in the crystalline. The hypothesis of the microheterogeneous structure of glass is based on their investigation of liquid slags, for which microheterogeneity was established. Change from liquid phase into vitreous state can only lead to increase in microheterogeneity, although liquation does not take place, since one region of microheterogeneity changes smoothly into a continuous region.

297. Eizo Kanai and Takeshi Satoh

"Transitional Phenomena of Glass," J. Phys. Soc., Japan 9, 417-24 (1954).

The investigation is limited to silicates glasses, in particular with about 70% SiO_2. Including transitional phenomena, the glassy state is explained through the superposition of network deformation and at. vibration around the instantaneous configuration. This math. theory is based on the introduction of the network temperature as a new parameter, a thermodynamical treatment which leads to an independent derivation of the equation of motion. Experimental data which are compared with this theory are taken from thermal expansion curves in ranges from 200° to 600°, and another check might be established by specific heat measurements, of which only insufficient data have been available. These latter are being studied by precise measurements by Kanai in the annealing range and shall be published at a later date. The rate of change of the n through cooling from 852°K. after Collyer (C.A. 42, 1035c) has also been utilized.

298. V. A. Kolesova

"Problem of the Interpretation of Vibration Spectra of the Silicates and the Silicate Glasses," Zhur. Eksptl. i Teoret. Fiz. 26, 124-7 (1954).

Kolesova considers in particular the vibrations ascribed to the SiO_4 group in the regions 8-12, 12-13, 17-2[illegible], and above 21μ, and concludes that Matossi and his students (cf. C.A. *32*, 4432[9]) have erred in their interpretations. The 12-13 μ band, in particular, cannot be considered as abs. proof for the presence of crystallite structure in silicate glasses.

299. J. V. Smith

"A Review of the Al-O and Si-O Distances," Acta Cryst. 7, 479-81 (1954).

A review of measured Al-O and Si-O distances leads to the values Al-O = 1.78 ± 0.02 and Si-O = 1.60 ± 0.01A. These values are of use in locating the positions of Al and Si atoms in feldspar and other structures by accurate measurements of distances in O tetrahedra.

300. V. V. Tarasov

"Quantum Theory of Heat Capacity and Structure of Silicate Glasses," Steklo i Keram., 11 (2) 6-9 (1954).

On the basis of a study of the heat capacity of Na_2SiO_3 glass at low temperatures and by analysis of the results with the aid of the quantum theory of the heat capacity of chain and layer structures, the existence of metasilicate chains in this glass is firmly established. Na disilicate possess a chain and not a layer structure in the vitreous and crystalline states. This method can be used to determine the structures of skeletons of both inorganic and organic daltonide glasses.

301. Scott Anderson, Robert L. Bohon, and Dudley D. Kimpton

"Infrared Spectra and Atomic Arrangements in Fused Boron Oxide and Soda Borate Glasses," J. Am. Ceram. Soc., 38 (10) 370-77 (1955).

The infrared absorption spectra of fused B_2O_3 and of a series of soda borate glasses are presented. These spectra were obtained by the use of vacuum-pressed briquettes of the powdered glass and powdered KBr. The spectrum of fused B_2O_3 shows quite definitely

that this glass does not consist of a completely continuous triangularly coordinative network. Hydrogen bonds play an important part in the atomic arrangement of the glasses of zero or low soda content. The B_2O_3 glass apparently consists of complexes of an approximate unit (B_9O_{14}) – held together by hydrogen bonds. One in nine borons is terahedrally coordinated. The glasses of low soda content are similar. The spectra for soda concentrations greater than 15% did not permit the determination of the atomic arrangement with exactitude, but it is quite different from that found in glasses with 10% Na_2O or less. 8 figures, 15 references.

302. Vittorio Garino-Canina

"Nature of Absorption Centers in Vitreous Silica," Compt. rend., 240, 1765-7 (1955); cf. C. A. 49, 2857b.

Samples which lose their absorption (and luminescence) band at 2400 A. by heating to 1000° regain it when heated for 1 hr. to 1300° in a reducing atmosphere. The band does not reappear if the heating is done in an exidizing medium. The absorbing centers are probably interstitial Si atoms, behaving in a manner similar to F centers in crystals.

303. M. Goldstein and T. H. Davies

"Glass Fibers with Oriented Chain Molecules," Am. Ceram. Soc., 38, 223-6 (July 1955).

Under drawing conditions indicated by theory of viscoelastic properties of high polymers, fibers of sodium metaphosphate glass were prepared that show birefringence and give x-ray diffraction patterns similar to those of organic fibers with oriented chain molecules; under analogous treatment sodium metasilicate failed to give such effects. Bibliography.

304. Klaus Kuhne

"Study of the Properties of Highly Siliceous Glasses with Respect to the Ions Built into the Glass and Their Position in the Periodic System of the Elements," Silikattech., 6 (5) 190-200 (1955).

To establish the specific action of the various ions on the silicic acid lattice with respect to electrical resistance, refraction of light, and density, an "ultramicroporous" glass was used. It is obtained by the lixiviation of a borosilicate with hot mineral acid and consists of almost pure SiO_2 with small amounts of B_2O_3 and Na_2O; the SiO_2 exists in the form of a continuous stable skeleton with fine uniformly distributed hollow spaces of an average radius of 20 to 60 a.u. These hollow spaces are first filled with distilled water, which is then replaced by aqueous metal salt solutions; an exchange of water with the salt solutions takes place by diffusion, and thus the different ions can be built into the glass. The salts of the metals to be used for this ion exchange are given, and the relations between ion radius, ion distance, and force of attraction of the ions and the specific resistance, refraction, and density are shown in diagrams and tables. The energies necessary to build up a glass are derived, and their effect on the possibility of introducing the different ions into the glass is explained. 12 figures, 5 references.

305. H. Moore and H. Winkelmann

"Colours of Nickel in Glasses of Various Types and Their Implications Concerning Glass Structure," Soc. Glass Tech. J., 39, 215-313 (October 1955).

Pt 1: Types of absorption spectra given by nickel in glass. Pt 2: Transmission curves given in glasses and sintered silicate masses. Pt 3: Absorption spectra in various solutions and in certain organic compounds; magnetic properties of nickel in various experimental glasses, in relation to state of nickel.

306 W. O. Statton and L. C. Hoffman

"Structure in Vitreous Silicates as Shown by Low-Angle Scattering of X-rays," Nature, 176 (4481) 561-62 (1955).

4 figures, 6 references.

307. C. E. Weir and L. Shartsis

"Compressibility of Binary Alkali Borate and Silicate Glasses at High Pressures," Am. Ceram. Soc., 38, 299-306 (September 1955).

Isothermal compressibility data at 21 C pressures between 1000 and 10,000 are reported; possible interpretations of data are discussed in terms of concepts of structure of glasses. Bibliography.

308. A. Winter

"Glass-Forming Materials," Cahiers de Phys., No. 57-58, 10-22 (May-June 1955). (In French.)

A fuller account of the idea that the glass-forming propensity of inorganic materials is mainly determined by the number of –electrons per atom: four is the optimum number, while no glasses with less than two are known (see Abstr. 3155 (1955). In support of the thesis is a fully documented table giving all known binary glasses with O, Se, S or Te as one of the components. It includes about 20 new glasses whose existence was surmised by the author on the basis of her rules.

309. A. Winter

"On the Structure of Vitreous Silica," C. R. Acad. Sci. (Paris), 240, No. 25, 2397-9 (June 20, 1955). (In French).

Accurate measurements of the refractive index of vitreous silica as a function of temperature shows a series of small discontinuities in slope and/or ordinate at the known transition temperatures of all the crystalline forms of silica. This is taken to imply that small regions of all these crystalline forms are present in vitreous state.

310. J. Volger and J. M. Stevels

"Electric Polarizability of Colour Centres in Quartz Crystals and Glasses," Philips Research Reports, 11, 1, Feb. 1956, p. 79-80.

Note in reference to dielectric losses observed; it is suggested that irradiation induced losses are due to orientational polarizability of color centers, at low temperatures trapped electrons or holes can be located on various positions between which (electrically active) transitions occur with rather low frequency.

(To be continued in July)

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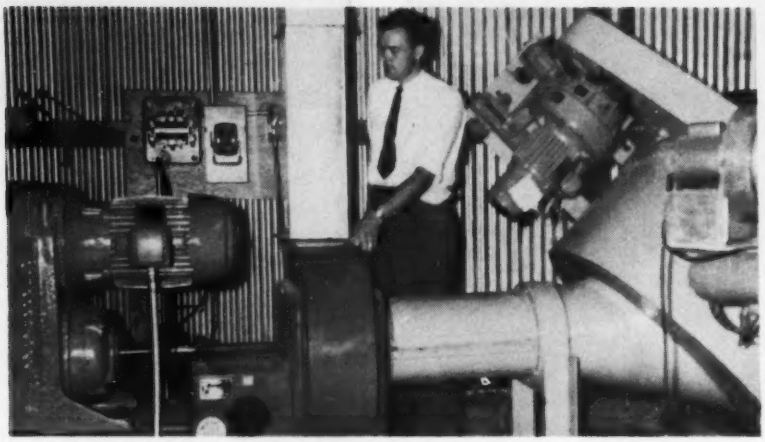

Fig. 1. Merrit Robinson, chief engineer at Kimball, checks over a new preforming machine. As shown here, motor covers are not in use.

THE CHALLENGE OF FIBER GLASS

Fiber glass is rapidly gaining acceptance as an ideal material for the construction of water skis, billboard trim, TV trays, and many other unusual items. Inherent in this expansion are some interesting design problems.

One of the unique features in the fabrication of fiber glass products is the demand for design ingenuity and technique development made upon the manufacturer. The processes in operation at Kimball Mfg. Corp., San Rafael, Calif., maker of fiber glass water skis, billboard trim, and custom molded products, illustrate this essential growth and change within the industry.

Preforming

Among the many challenges which fiber glass presents to the fabricator is the need for continual improvement of machinery and equipment. Fig. 1 shows a new preforming machine which automates most previously manual operations, speeding up production of some items by as much as 300 per cent. As illustrated here, the fiber glass roving winds into a cutter where it is chopped into 2-in. strands. The strands are then blown by a fan through a 3-in. flexible duct to the vicinity of the preforming screen. At the same time, a sticky binding material is sprayed on the building preform and the glass strands are deflected into the desired glass pattern.

When the machine stops momentarily, the operator strips off the preform and puts it on an indexing 4-position oven turntable (Fig. 2). There the binder is secured and taken to a specially designed press where polyester resin is added. The performing unit also handles binder application, glass cutting, and cycle timing automatically.

Vari-Drive

A vari-drive speed control mechanism is integrated into

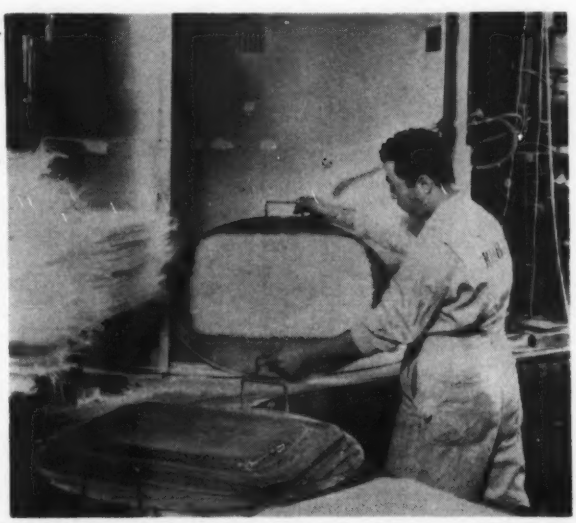

Fig. 2. Preformed TV tray about to be stripped from preforming screen and placed on indexing 4-position oven turntable.

Fig. 3. Kimball vice-president Bob Mallory (left) checks press operation for new custom product.

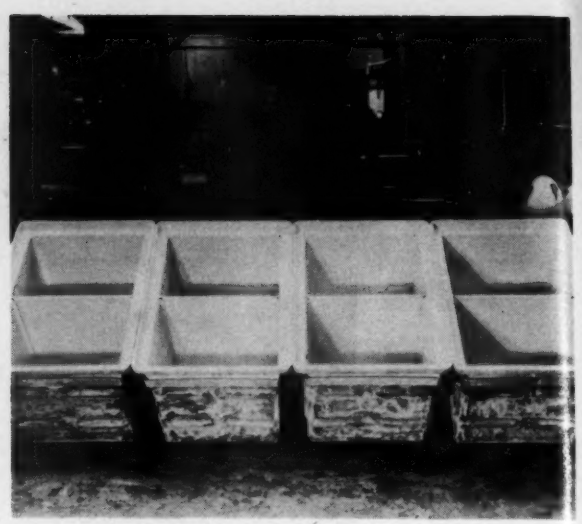

Fig. 4. Fiber glass tanks produced for Hewlett-Packard Co., Palo Alto Calif., will be used in metal plating operations.

the operation of the preforming unit to steadily speed up a 27-in. fan which pulls air through the preforming screen. In this way, the fan can maintain constant suction even though air flow is partially blocked by fibers collecting on the screen. Where suction formerly dwindled to just barely enough for distributing the fibers, this technique now insures more firmer placing of fibers and more even distribution.

Special Molding

Custom molding of intricate forms and specialized products (Fig. 3) has become an important part of the fiber glass industry. Not too long ago, a battery of fiber glass tanks to be used in a newly-completed metal plating facility (Fig. 4) were turned out at Kimball.

In the process of fabricating these particular items, three layers of fiber glass mat and polyester resin, applied by double-barrelled spray guns with glass chopper attachments, were laid on and pressed flat with metal rollers. Most of the work was done by hand, and the resin was allowed to cure at room temperature. These tanks are extremely rigid as well as chemically, thermally, and electrically inert. They also resist corrosion and are expected to last five times as long as conventional metal tanks.

For the production of billboard trim, Kimball has installed a press (Fig. 5) capable of pressures up to 100 tons. It has a C-frame suspension as opposed to the conventional "4-post" model, and is expected to boost efficiency by simplifying the installation and removal of molds.

Two layers of fiber glass mat are placed in the mold and a weighed amount of resin poured over them by

(*Continued on page* 287)

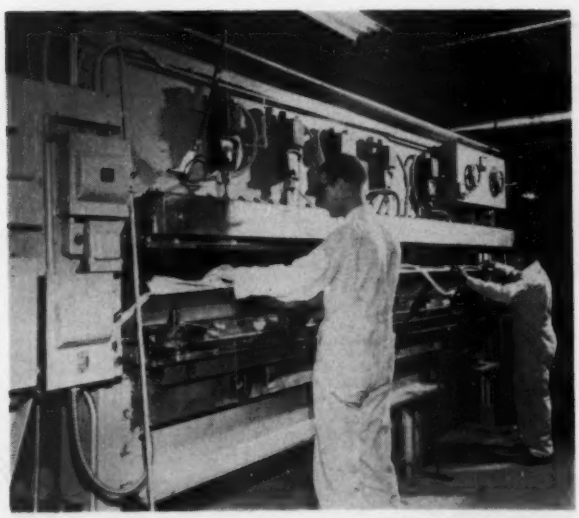

Fig. 5. Operators remove newly pressed piece of billboard trim from mold.

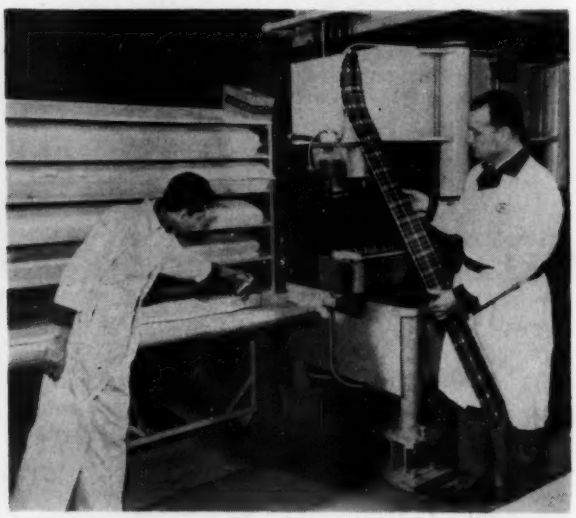

Fig. 6. Operator adds polyester resin to fiber glass mat during water ski production.

DITTO

That word "ditto"—meaning "the same as before" — appropriately symbolizes the heating precision of Surface Combustion lehrs and kilns.

Every glass section receives a uniform heat exchange by the almost cyclonic recirculation of heating and cooling gases. Individually-controlled zones meet the closest thermal tolerances. Mechanical interruptions have been engineered out of Surface Combustion equipment with the knowledge gained from hundreds of installations for the ceramic industries.

Thus, the glassmaker can be confident that once he plots his time-temperature curve, each successive cycle in a Surface Combustion unit will be "—the same as before.

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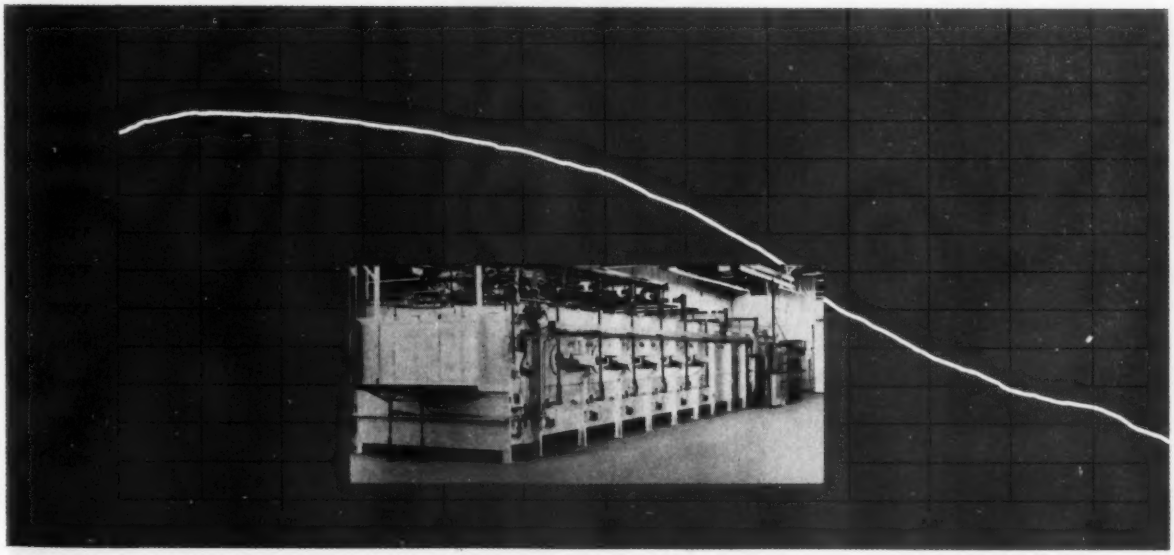


NEWS

Joseph L. Tillmann, III

Roger C. Schmidt

Harry H. Chapman

The Advance Products Co.

Toledo, O., has been reorganized as UnitPlastics, Inc., continuing the manufacture of fiber glass reinforced products. The company is scheduled to move soon to enlarged quarters in Liberty Center, O.

Joseph L. Tillman, III, vice-president of Unitcast Corp., also of Toledo, has been named president of the new firm. Roger C. Schmidt, who with his brother, Gerald, founded Advance Products in 1950, will be sales manager, and Gerald Schmidt, general superintendent.

Molded Fiber Glass Co.

Has doubled the capacity of its polyester resin plant at Ashtabula, O. The expansion was engineered specifically for the production of isophthalic-based resins with optimum stability and improved color.

The recently-completed facilities will raise production volume to 10,000,000 lb. per year. (The original installation went into operation in December, 1959, with a capacity of 5,000,000 lb.) Total output of the plant will go to the five affiliated MFG companies, with the associated Molded Fiber Glass Research Co. handling resin development and quality control.

Wilson Brothers

In exchange for an undisclosed number of common shares has acquired the remaining 50 per cent of the stock of Parallite Manufacturing Co., Export, Pa., from Dr. Albert H. Lasday and other Pittsburgh businessmen. Parallite, formerly a 50 per cent owned affiliate, will become a wholly-owned subsidiary of Wilson.

Parallite equipment and personnel will be moved to the Point Marion, Pa. facility of the Houze Glass Corp., all of whose common stock was acquired by Wilson last December. Here Parallite will continue in the development and production of a high-strength glass fiber reinforced plastic with a unidirectional flexural strength of up to 250,000 lb. per sq. in.

Richard A. Matthews

Richard A. Matthews

Sales supervisor of heating and air conditioning products for the sales to manufacturers marketing division, Owens-Corning Fiberglas Corp. He was formerly a sales representative in the firm's Louisville branch office, and will make his new headquarters in Toledo.

Joseph V. Spitale, Jr.

Production supervisor, Warminster Fiberglass Co., with responsibility for the firm's quality control, research, and development programs, and for production.

Harry H. Chapman

Manager of transportation sales, Owens-Corning Fiberglas Corp.'s sales division. He will be in charge of development of new applications of insulation, fiber glass reinforced plastics, and other products for the automotive, railroad, truck-trailer, aircraft, packaging, and pipeline fields.

Chapman, a member of the American Institute of Electrical Engineering, has been supervisor of the firm's electrical apparatus sales for the past seven years. Last year he was chairman of the Electrical Insulation Application Conference in Washington, D. C.

Richard F. Siefert

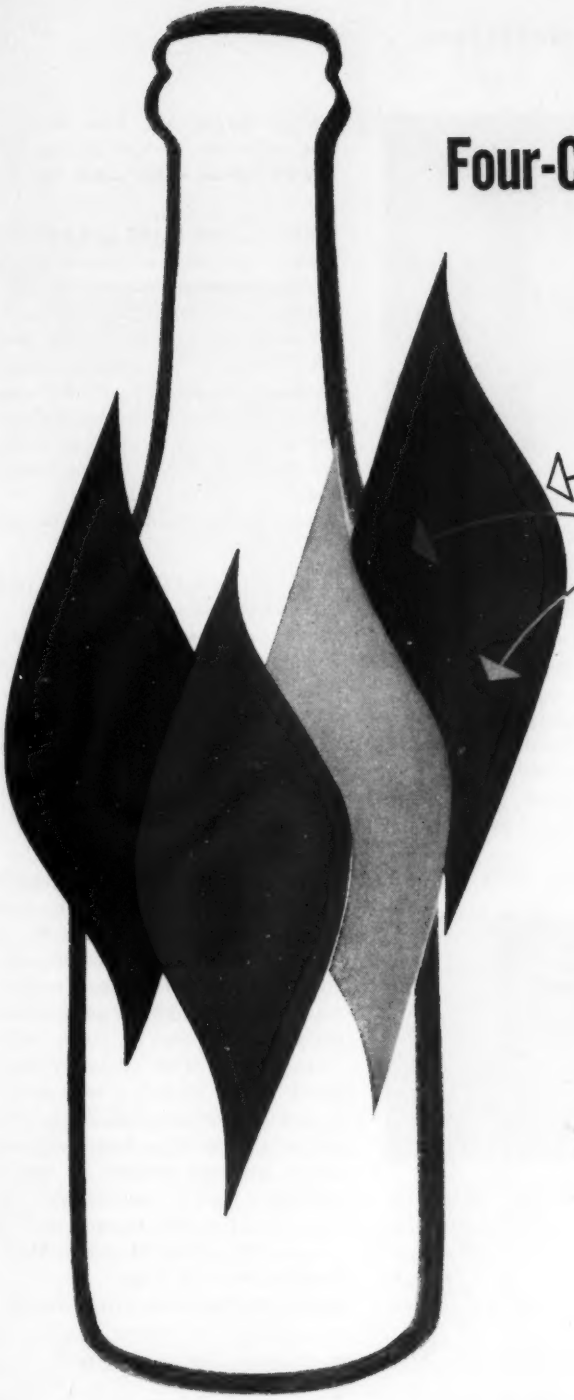
In the newly-created position of manager of filament winding marketing, Pittsburgh Plate Glass Co.'s fiber glass division. He transfers to the company's Pittsburgh general office from Chicago where he served as fiber glass division district manager during the past year. Succeeding him there is Carl H. Luther, formerly sales representative for the mid-western sales office.

Donald K. David

Elected to the board of directors, Gustin-Bacon Mfg. Co., and J. O. Biggs appointed secretary of the firm.

David, vice-chairman of the board of the Ford Foundation, will succeed J. D. Simmons, a former president of the company, who resigned from the board.

Biggs, recently an assistant secretary, will continue to function as director of labor and personnel. He succeeds retiring Leo M. Kelly who will remain a director of the firm.



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Applications...

Prefabricated schools are 59 ft. by 20 ft., and consist of one large classroom (shown here) accomodating 50 students, plus living quarters for the teacher and his or her family. Fiber glass windows achieve a stained glass effect with imbedded Mexican cultural motifs.

PREFABRICATED RURAL SCHOOLS, 20,000 of which are to be built by the Mexican government over the next 10 years, will incorporate sanitary units, dividing partitions, window panels and vents, conduits, and a spherical water tank—all of fiber glass reinforced plastic construction.

The most unique of these applications, and said to be the first of its kind ever produced, is the completely molded bathroom and kitchen. Featuring a single-feed/single-drain principle, the system eliminates the need for a complex and costly network of pipes and connections. *Vitro-Fibras, S.A., Molde, S.A., Transolite, S.A., and Lapsolite, S.A.*

Reader Service Card: Circle No. 50

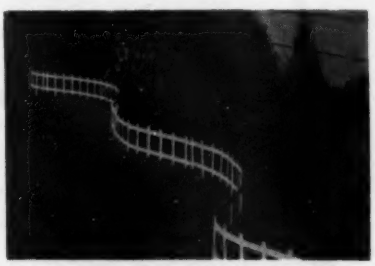
HIGH-TEMPERATURE INSULATION, under development for several years, has now been assigned as a standard product, having cleared all the hurdles of pilot plant production and field testing. The material, called "Fiberfrax" ceramic fiber, is a mix of high-grade alumina and silica sand which is heated to 3900°F and is poured in a molten stream the size of a lead pencil. The stream in turn is struck with a blast of air or spun into fibers of varying lengths. These fibers are fabricated into more than 40 forms, such as blocks, sheets, textiles, rope, castables, and molded forms. Material withstands continuous operating temperatures up to 2300°F. *The Carborundum Co.*

Reader Service Card: Circle No. 51

FIBER GLASS is the reinforcement used in plastic building panels which simulate the shape, color and contour of natural stone. Used to improve the appearance of building exteriors, where they give the effect of actual stone construction, the panels can also be applied in interior decoration.

Now being manufactured in 1- by 4-ft. sizes, the panels can be applied over weather boarding, wood sheathing insulation board, stucco, cinder block, cement and other surfaces. *Tetrox Corp. of America.*

Reader Service Card: Circle No. 52



FLEXIBLE PICKET BORDER FENCES of specially formulated fiber glass reinforced plastic need no painting and eliminate the problems of rust, rot, and corrosion. *Northern Fiberglass Inc.*

Reader Service Card: Circle No. 53

HELICOPTER ROTOR BLADES constructed of load-oriented glass filaments precision molded in a modified epoxy resin are said to offer improved blade fatigue resistance, major savings in production, and reduced maintenance costs. The use of fiber glass in aircraft production also eliminates overhaul problems caused by corrosion and weathering, and color pigmentation of the material will make supplemental finishes unnecessary. Test flights are now under way. *Kaman Aircraft Corp.*

Reader Service Card: Circle No. 54

FIBER GLASS DUST COLLECTORS treated with silicones operate continuously at temperatures up to 600°F. Silicone treatment of the bag-type dust collectors has increased their service life 25 times by reducing filament breakage and abrasive wear of the glass fabric. Efficiency of mechanical shaking and reverse air flow cleaning methods are increased. *Owens-Corning Fiberglas Corp.*

Reader Service Card: Circle No. 55

FIBER GLASS FILTER BAG DUST COLLECTORS, installed in 4 of the 16 cement plants located throughout Pennsylvania's Lehigh Valley, have substantially reduced the 730-ton per sq. mi. dustfall recorded every month in that area before air pollution control was undertaken. These filters, which remove over 99 per cent of the cement dust, are the newest of six basic means for industrial dust collection.

Used principally for high-temperature filtration (temperatures in excess of 500°F are typical in the cement industry), the fiber glass fabric system also shows excellent resistance to chemical attack. Although budget limitations prevent all of the 16 plants in the "cement belt" from converting immediately to this method, it is hoped that long-range planning will bring about the solution of a problem which has caused property damage as high as $300,000 a year in one township. The cost of total control to each manufacturer will be at least $1 million. *Owens-Corning Fiberglas Corp.*

Reader Service Card: Circle No. 56

CATALOGS RECEIVED

Textile yarn products. From raw materials to eight different types of yarns and textile fibers—regular, colored, bonded strand, Teflon-coated, glass-dacron, asphalt saturated plus roving, chopped strand, and chopped strand mat. A comparison chart details properties of glass, asbestos, cotton, nylon, and dacron. *Johns-Manville Fiber Glass Dir*

Reader Service Card: Circle No. 57

NEWS
IN THE GLASS INDUSTRY

Personalities...

John L. Gushman

William V. Fisher

I. J. Collins

John L. Gushman

Elected president, chief operating officer, and a director of Anchor Hocking Glass Corp. He was formerly vice-president of Owens-Illinois Glass Co. and president of Owens-Illinois International.

William V. Fisher, president of the corporation for the past 17 years, has been named chairman of the board and chief executive officer. I. J. Collins, chairman of the board since 1944 and founder of Anchor Hocking's predecessor company in 1904, has been elected chairman of the executive and finance committees.

Andre Mandois

Vice-president, sales, American-Saint Gobain Corp., in charge of the company's nationwide flat glass sales organization. Formerly with Compagnie de Saint Gobain of Paris, where he served as director of export sales, Mandois was previously responsible for that firm's marketing operations in Great Britain.

H. W. McIntosh will assume the newly-created post of vice-president, international licensing services. He joined American-Saint Gobain in 1945, and most recently held the position of vice-president, technical services. Succeeding him in this capacity will be J. P. Schrader, who transfers from Compagnie de Saint Gobain with technical experience.

Other assignments within the company include S. S. Benedict, director of industrial relations...D. F. Ridings, Jr., promotion manager for the firm's complete line of glassware . . . A. S. Crandon, Jr., director of window glass development . . . H. D. Musick, corporate traffic manager . . . E. R. Easterling, Sr., field sales manager . . . B. P. Rucker, manager of training . . . T. W. Glynn, director of plate and rolled glass development . . . J. E. Rigby, director of engineering . . . R. B. Seipel, manager of the Kingsport plant.

Pierre L. Roederer

Operations manager of Corning Glass International, a subsidiary of Corning Glass Works, with Leroy Wilson succeeding him as manager of industrial bulb sales.

Richard H. Andrews has been appointed manager of Corning's New York City public relations office. He will continue to serve as executive director and vice-president of the Corning Glass Works Foundation.

Charles J. Lucy has been named manager of market development for the company's electronic components department, and Stuart B. Pollock, field sales representative for the eastern sales district of the technical products division.

Ebon C. Jones

Vice-president and manager of market planning and administration, Owens-Illinois Glass Co.'s eastern glass container division, with responsibility for all general office sales functions. This appointment is in line with the company's reorganization of marketing operations east of the Rockies. Each of three newly-created geographical regions—eastern, southern, and midwestern—will be under the dual control of a regional factories manager and a regional sales manager, as follows:

Robert F. Miller, sales, and Earle G. Ingels, factories, eastern region with headquarters in New York City; Kevin K. Hepp, sales, and Milan G. Kahl, factories, midwestern region with headquarters in Chicago; Frank Jones, Jr., sales, and Harold Ottesen, factories, southern region with headquarters in Atlanta.

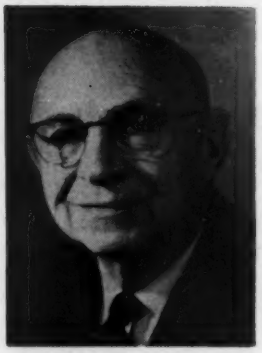
Keith Conrad becomes chief engineer of the glass container division with headquarters in Toledo. Formerly chief engineer of the firm's Pacific Coast division, he succeeds J. E. McBurney whose new assignment will be announced later this year.

John H. Clarke

Vice-president of the systems division, CompuDyne Corp., manufacturers of computer-operated automatic control systems and related electronic, hydraulic, and mechanical instrumentation for the aircraft, missile, and industrial process fields.

Lamar D. Roy, Jr.

District sales manager in Louisville, Ky., for the Hazel-Atlas Glass Division of Continental Can Co.



Charles F. Claughsey

Robert E. Widing

In newly-created position of manufacturing manager, and Dr. Howard H. Hoekje, manager of applied organic research, Pittsburgh Plate Glass Co.'s chemical division (formerly Columbia-Southern Chemical Corp.). Widing, who has served as assistant works manager at the Barberton, O., plant since 1956, will headquarter at the firm's Pittsburgh general office.

Frank E. Moore has retired as general traffic manager of the chemical division after 26 years of service.

R. E. Collins

Appointed president of Vaculator Co., Inc., manufacturers of industrial dust collection equipment. The company has recently moved from New York to new quarters in Newark, N. J.

William R. Crawford

Has retired after 52 years in the flat glass industry, 30 of which were spent with Libbey-Owens-Ford Glass Co.

C. Glen Bigelow, Jr.

Vice-president, research, Selas Corp. of America. With the firm as director of research since 1958, he was formerly associated with American Machine and Foundry Co.

C. Glen Bigelow, Jr.

Charles F. Claughsey

Named to the central management staff of Emhart Mfg. Co. as consultant to the executive vice-president. Previously chief application engineer at the company's Hartford division, he will be succeeded by John E. Crouse who assumes the post of manager of technical sales and services there.

Edward O. Carlton

And Leonard L. Lyle, sales representatives, American Potash & Chemical Corp. Carlton will make his headquarters in Kansas City, Mo., and Lyle in the Shreveport, La., district office.

J. Earl Burrell

Vice-president of operations for the chemical division of Pittsburgh Plate Glass Co. He has served as general manager of operations since 1958, and was previously assistant to the vice-president, operations.

J. Earl Burrell

The firm's glass division has announced the following appointments at its research laboratories: Dr. F. M. Ernsberger and O. D. Englehart, assistant directors of research, Harmar Township, Pa.; Dr. George A. Simmons, Jr., coordinator of melting operations, melting and forming division, Creighton, Pa.; S. M. Dodds, manager of research services, Harmar Township, succeeding Dr. Simmons.

John P. Kasurin

And John H. Hartzell, sales representatives, Pittsburgh Corning Corp. Kasurin will be attached to the Detroit territory, and Hartzell, Colorado.

John A. Cloud, Jr.

Sales manager, Chas. A. Koch Glass Co., a subsidiary of Libbey-Owens-Ford. He will have direct supervision over a sales force of eight, and responsibility for all sales.

John E. Crouse

Leonard Kennedy

Plant manager at Walsh Refractories Corp.'s Vandalia, Mo., factory.

Dr. Alan B. Gancy

Supervisor of the physical chemical section, inorganic research and development department, Food Machinery & Chemical Corp.

Robert E. Cochran has been made assistant manager of sales for the firm's Chlor-Alkali division, with Richard M. Hoyer succeeding him as alkali product manager.

Edward F. Coakley

Sales representative for the New England district, General Electric's silicone products department, with headquarters in Boston, Mass.

Floyd M. Maupin

Director of engineering, and Dr. James A. Crookstom, director of research, A. P. Green Fire Brick Co.

J. J. Offutt has been elected to the board of directors to fill the unexpired term of W. H. Peterson, Sr., who recently resigned after holding that position for 11 years. Offutt will continue as vice-president and general manager of the company.

Floyd M. Maupin

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Present at the Alfred Victor Bleininger Award Dinner held March 10 at the Pittsburgh Athletic Association were (left to right) Donald F. Stock, chairman of the Bleininger award and program committees, Dr. H. W. Armistead, guest speaker, Dr. Samuel R. Scholes, toastmaster, Dr. Eugene C. Sullivan, recipient of the award, Frank H. McRitchie, chairman of the Pittsburgh section, American Ceramic Society, Dr. G. H. Spencer-Strong, president, A. C. S., and John S. Nordyke, president-elect, A. C. S.

Inland Container Corp. Forms New Glass Company

The newly-created Fairmount Glass Corp. will function as a wholly-owned subsidiary of Inland, and has recently acquired the operating properties and certain other assets of Fairmount Glass Works, Inc. Inland, founded in Indianapolis in 1925, is one of the nation's largest producers of corrugated shipping containers, and Fairmount Glass Works has been established there for 55 years.

Glass Bottle Blowers Assn. Elects Officers

Lee W. Minton, president of the union, AFL-CIO, since 1946, has been re-elected for another 4-year term. Also re-elected at the 63rd annual convention in Los Angeles, Calif., were vice-president Raymond Dalton, secretary Newton Black, and treasurer Dale Clutter.

American-Saint Gobain Corp.

To relocate its main offices in Kingsport, Tenn., consolidating administrative and manufacturing facilities there.

Alfred University Conducts Glass Tour

A group of five students of glass technology at the New York College of Ceramics, Alfred University, recently completed a 5-day, 1200-mi. trip through Ohio, during which they visited several flat glass, fiber glass, and electronics plants in their study of the latest production methods and processes involved in the manufacture of glass.

Virginia Mirror Co., Inc.

Has recently installed custom designed equipment to implement the firm's new "Thermo-Fuse" process and increase production.

Cambridge Wire Cloth Co.

Has announced the opening of a wire cloth warehouse facility in Houston, Texas, with Edward F. Pink as warehouse manager. This new location will make available all of the most frequently used grades of wire cloth in standard metal-mesh sizes for immediate shipment to customers in the Southwest. The Houston sales office, under the direction of Charles E. Shuman, will also have its headquarters at the warehouse.

Kimble Glass Co.

Has launched a two-fold expansion program to broaden production of scientific and laboratory glassware at its Vineland, N. J., plant. Manufacturing and warehouse facilities now under construction there are scheduled for completion before the end of the year, and two new furnaces which will serve in the forming of borosilicate "Kimax" glass will be operating in the existing plant within 6 months. These additions are expected to more than double the company's output of "hard" glass.

W. P. Fuller & Co.

Broke ground March 1 for its new northern California glass depot in Union City. The installation, representing an investment of between $500,000 and $600,000, is scheduled for operation in midyear. The 73,000-sq. ft. facility will serve as a distribution center for all flat glass, auto glass, glass and aluminum doors and windows, and other glass products handled by the firm in that area.

L. R. Templeton has been named manager of the new depot, with R. Gentry, former manager of the company's Nampa, Idaho, store, succeeding him as Boise district manager. R. H. Lindbloom becomes manager of the Nampa store, and D. Brian succeeds him as manager of the Idaho St. store in Boise.

Mineral Discovery of Interest to Glass Industry

Wollastonite has been found to be present in 59 per cent of the ore quarried in exploratory drillings being carried on at Lewis, N. Y., in the Adirondack Mountains. The site of the discovery is approximately ten miles from Willsboro, N. Y., where the first and only commercial source of wollastonite in the world, mined and processed by the Cabot Corp. of Boston, Mass., is located. Fifty per cent of the sales of this mineral are to the ceramic industry, 30 per cent for use in paint, paper, and chemical compounds such as fiber glass, and 20 per cent for miscellaneous uses in building materials and metallurgical products.

PPG Joins Armour in Potash Testing Program

The two firms announced plans last month for a $1 million pilot plant and test wells to be used in the experimental solution mining of potash. Drilling has already begun on a property 18 mi. east of Moosejaw, Sask., Canada.

In solution mining, water is pumped into the mineral deposit; the mineral is dissolved in water and then recovered from solution above ground. This new method will compete with the existing rock mining process.

Following successful pilot operations, Pittsburgh Plate and Armour will form a joint company to produce muriate of potash. Data gathered during operation of the experimental unit will provide groundwork for the design of a multimillion dollar commercial plant to be constructed by the joint venture in Canada. Armour requires large amounts of potash for use in fertilizers produced by the Armour Agricultural Chemical Co.

American Institute of Industrial Engineers

Will be the guest of the Detroit chapter at the society's 12th Annual National Conference and Convention, May 11-13 at the Sheraton Cadillac Hotel, Detroit. The program will include, among other things, a presentation of technical papers and industrial exhibits, and a one-day symposium for chief engineers.

Ceramic Fellowship Projects

The Lead Industries Association announced that nine projects are being covered by ceramic research fellowships during the 1960-61 academic year. Among the projects are: Phase Equilibria & Physical Property Measurement in Lead Oxide Systems, Professor F. A. Hummel and Fellow Argyle, The Pennsylvania State University, and Fundamental Behavior of Lead in Glasses, Professor C. H. Greene and Fellow S. Hajjar, Alfred University.

Other projects range from ferroelectric materials to improved glazes.

M.I.T. Announces Special Summer Program

Among the 26 one- and 2-week courses scheduled are ten 3-hour lecture and discussion periods on adhesive joints (June 26-30), and a program on the continuous glass making process (July 17-28). Further information and application blanks, to be requested as soon as possible, can be obtained from the Office of Summer Sessions, Massachusetts Institute of Technology, Cambridge 39, Mass.

1961 Gordon Research Conferences

"Electrical and Relaxation Processes in Glass" will be the topic of the Tilton, N. H., meeting, to be held at the Tilton School, August 7-11.

The following is an outline of the scheduled program. For registration and further information, write W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I.

AUGUST 7

The Dielectric Relaxation of Glass Due to the Movement of Alkali Ions. H. E. Taylor.

Electrical Conduction in Glass. J. O. Isard.

Comparison of Conduction and Relaxation Processes in Glass. A. E. Owen.

AUGUST 8

Space Charge and Electrode Polarization. P. M. Sutton.

A Defect Model of Diffusion in Glass. R. J. Charles.

On the Free Sodium Ion in Glass. T. Abe.

The Electrochemical Properties of Cation-Sensitive Glass Electrodes and the Atomic Basis of Their Cation Discrimination. G. Eisenman.

AUGUST 9

Internal Friction of Alkali Silicate Glasses. R. J. Ryder.

Subject to be announced. I. I. Kitaigorodskii.

The Glass Transition. D. Turnbull.

AUGUST 10

Nuclear Magnetic Resonance Studies of the Structure of Glass. P. D. Bray.

Structure and Properties of Glass Fibers. M. Aslanova.

Structural Relaxation in Liquids (Molten Glasses). T. A. Litovitz.

AUGUST 11

Discussions and business meeting.

Penn State Plans Course in Electron Microscopy

A 2-week lecture program for research workers in the physical sciences has been scheduled for September 3-15. Topics covered will include basic theory of electron optics, instrumentation, electron diffraction, specimen preparation techniques, and applications. Laboratory facilities will be available.

For further information, contact Prof. Joseph J. Comer, College of Mineral Industries, The Pennsylvania State University, University Park, Pa.

Glass Industry To Be Represented at Health Conference

Alexander M. Turner and Herb Barnby, Owens-Illinois Glass Co., will present a paper on the needs for the glass industry at the Second Congress on Environmental Health, to be held at the University of Michigan in Ann Arbor, June 6-8.

The meeting, conducted by the School of Public Health and the National Sanitation Foundation in collaboration with the American Public Health Association, will be attended by 250 participants from professional public health agencies, industry, and the general public.

Glass on Display

The 1961 U.S. World Trade Fair, May 3-13 at the New York Colliseum, features a display of china, glassware, and ceramics in the imported gift and houseware exhibit.

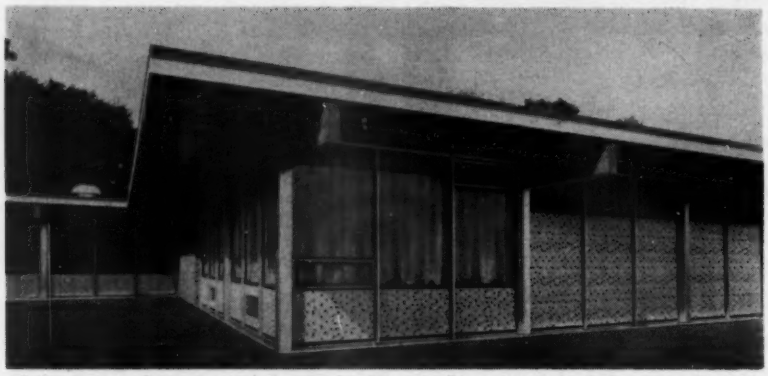
AMERICAN SCIENTIFIC GLASSBLOWERS SOCIETY*

6th Symposium, Annual Meeting, and Exhibit

1. **Alumino Silicate Glasses—Latest Developments and Uses.** Dr. F. L. BISHOP, Kimble Glass Co., Toledo, O.
2. **Techniques for Laboratory Working of Alumino Silicate Glasses.** J. F. BARDOUR, H. W. BENSON, F. M. COLLINS, and D. J. JANSEN, Linfield Research Institute, McMinnville, Ore.
3. **Properties and Applications of Devitrifying Solder Glass.** F. W. MARTIN, Corning Glass Works, Corning, N.Y.
4. **Metal Diffusion Techniques and Glass Sealing Problems in the Electron Tube Industry.** RICHARD WACHTELL, Chromalloy Corp., West Nyack, N. Y., and H. W. LEIGHTON, Electron Technology, Kearney, N.J.
5. **Vacuum Forming of Glass.** OSCAR H. GRAUER, Fischer & Porter Co., Warminster, Pa.
6. **Use of Devitrifiable Solder Glass in Experimental Vacuum Devices.** DANIEL E. GEORGE and KENNETH D. EARLEY, General Telephone and Electronics Lab., Inc., Bayside, N. Y.
7. **Solder Glass Sealed Vacuum Envelope To Operate at 500°C Ambient Temperature.** HILMAR M. HEYN and KENNETH L. ROHRER.
8. **Some Aspects of Technical Training in Laboratory Glassblowing as Practiced in Europe.** ANTHONY J. HAWKINS, New York College of Ceramics, Alfred, N. Y.
9. **Annealing of Glass—The Practical Approach.** E. M. TOM, Kimble Glass Co., Toledo, O.
10. **High-Temperature Glasses.** THOMAS H. ELMER.
11. **Radioactive Damage to Glass.** Chathem Labs.
12. **Release of Alkalies and Flourine from Glasses and Their Influence on Glass Sealing.** DR. JOSEF FRANCEL, Kimble Glass Co., Toledo, O.
13. **Ceramics for Electron Devices.** DR. MORRIS BERG, R.C.A. Lab., Lancaster, Pa.
14. **Case of Glass-to-Metal Vacuum Envelopes vs. Metal-to-Ceramic Vacuum Envelopes for Electron Tubes.** GERALD W. KARLSRUHER, General Telephone and Electronics Lab., Inc., Bayside, N. Y.
15. **Glass in Space.** ARTHUR F. SHOEMAKER, Windshield Group, Corning, N. Y.
16. **Low-Temperature Solder Glasses in the Electron Tube Industry.** J. L. GALLUP, R.C.A. Lab., Harrison, Pa.
17. **Mechanical Requirements for Solder Glass Seals on Glass.** ROBERT R. KEGG, Kimble Glass Co., Toledo, O.

*May 24, 25, 26, Hotel New Yorker, New York, New York.

NEW APPLICATIONS IN GLASS...



Black neoprene lines accent design in the "Zipperwall" construction of the Cassopolis High School building, Cassopolis, Mich. Use of the system here has proven it to be unusually leak-free and efficient in reducing heat loss.

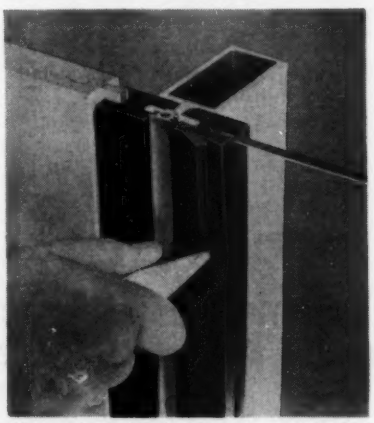
Curtain Wall with a Zipper

An architectural wall system employing structural neoprene weatherstripping which can be "zipped" to secure frame components hermetically has been designed to meet the demands of low-budget school and commercial building. The "H" shaped neoprene extrusion acts to eliminate all glass-to-metal contact in connecting most of the components, thereby providing a curtain wall which overcomes the problem of condensation.

Used as horizontal members, the gaskets become a part of the wall framing, and in this capacity, transmit loads arising from glass and panel weight to the mullion itself. Structural horizontal members are no longer necessary in the 1- and 2-story applications for which this concept has primarily been developed.

The "Zipperwall" system can be detailed and assembled in the field at a minimum labor cost. Factory fabricated, it includes aluminum mullions, panels, windows, and adjustable perimeters. All parts except mullions are cut to size from stock lengths on the job. Mullions are delivered in dimensions specified by the architect and require only two clips and screws at top and bottom for assembly. Sections can be "zipped" out to replace broken panes or to vary the decorative and practical arrangement of glass, panels of other materials, and vents.

This new approach to curtain wall construction, suited to accommodate either ¼-in. or flanged 1-in. glass panels, is credited with improved insulating and weatherproofing factors, as well as ease and speed of detailing, assembly, and installation. *Kawneer Co.*



With exclusive hand tool, "zipper" is locked into place.

Reader Service Card: Circle No. 58

Glass for Defense

Radio noise-free lighting equipment being installed in defense communication centers, electronics laboratories, radio telescope stations, power stations, screen rooms, and computer centers incorporates a prismatic glass diffusing lens to which a thin, molecular, light-transparent layer of pure metal is permanently bonded. The edges of the lens, used in combination with a completely RF shielded housing assembly, are provided with a gold-plated border which makes total contact with the steel housing through an intermediate gasket of compressible metallic braiding.

According to the manufacturer, this method of construction prevents interference generated by fluorescent lamps from being radiated into the surrounding area when the housing is properly grounded electrically. Designed for specific military and commercial requirements, the new RF units permit the installation of fluorescent lighting in many areas formerly limited to the use of less desirable incandescent equipment. *Ender-Monarch Corp., div. of Acoustica Associates, Inc.*

Reader Service Card: Circle No. 59

Life-Indicating Tubes

New thyratron and diode tubes change color from normal blue to neon red 300 hours before failure allowing ample time for replacement and minimizing the possibility of machine downtime. Now available in 2.5- and 6.4-ampere ratings, pin or lug base, the design is also said to double tube life. *Reliance Electric & Engineering Co.*

Reader Service Card: Circle No. 60

Cellular Glass Sound Insulation

Units of cellular glass, 13½ in. square by 2 in. thick, are perforated with dozens of tiny holes and converted by a process that opens normally closed cells to expose a labyrinth of sound-trapping chambers. These blocks, called "Geocoustic" units, are said to be particularly effective in such locations as sound studios where exacting acoustical standards must be met. *Pittsburgh Corning Corp.*

Reader Service Card: Circle No. 61

Ground Glass Stoppers

Are now available to the chemical industry for use with 13-gal. carboys. *Glass Products Div., Arrowhead & Puritas Waters Inc.*

Reader Service Card: Circle No. 62

High-Temperature Glass-to-Metal Seal

Ferrous alloy or metal and molybdenum seals capable of withstanding 500°F to 600°F temperatures and not damaged by temperatures of nearly 800°F for short periods have performed well above standard glass-to-metal seals which generally deteriorate rapidly at these elevated temperatures. The new glass is also said to possess improved mechanical strength and great potential as a replacement for many ceramic-to-metal seals in current use. Glass-to-metal seals have wide application in data processing computers and other missile equipment, and in commercial and military aviation and marine equipment. *Hermetite Corp.*

Reader Service Card: Circle No. 63

Lens Production Expanded

The achromat lens, previously available up to only 6 microns, is now being produced in the full 1-through-14 micron spectrum. The manufacturer of this lens and of infrared transmitting "Servofrax (R)" (arsenic trisulfide) glass has also announced the institution of a new computer program to facilitate custom design of the IR achromat. Both advances are expected to aid in improving future infrared devices for military and industrial applications. *Servo Corp.*

Reader Service Card: Circle No. 64

Porous Glass for Chromatography

Porous glass has been introduced experimentally as a medium for the chromatographic identification of writing fluids and fountain pen inks. Chemical inertness, transparency which enables the chromatograms to be examined optically, excellent resolution in a short distance, heat resistance allowing further development of the pattern, and acid resistance permitting the use of acid solvents are the advantages in the field of chromatography with which glass has been credited. *Corning Glass Works.*

Reader Service Card: Circle No. 65

Wall Mirrors

Distortion-free glass is being used in a new line of popularly priced wall mirrors, the "Contemporary Series" and "Pearlite Mirror Gems." These products feature decorative metal frames, pressed wood backs, and rust-proof hangers. *Hamilton Glass Co.*

Reader Service Card: Circle No. 66

Showering with Safety Glass

Shower and tub enclosures glazed with tempered safety glass are claimed to provide up to five times more resistance to impact than ordinary glass of equal thickness, and eight times more resistance to both hot and cold thermal shock. The glass, having been tested by people bouncing on it like a diving board, boxers punishing it with roundhouse punches, and automatic pitching machines heaving baseballs against it at the rate of 45 mph, has been declared unbreakable under normal usage. *Shower Door Co.*

Reader Service Card: Circle No. 67

Replaceable Tubulation for Filter Flasks

Tooled glass tubulation with a neoprene rubber grommet at the base has been introduced in a Pyrex filter flask to eliminate replacement of the entire flask in cases of tubulation breakage, the most frequent instance of flask damage. Reported by the manufacturer to have been successfully tested under vacuum,

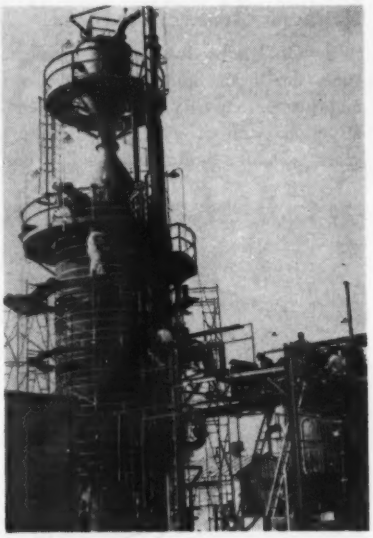
these flasks are available in capacities of 250, 500, and 1000 ml. *Corning Glass Works.*

Reader Service Card: Circle No. 68

Glass Reduces Cost of Salt Water Conversion

The use of "Foamglas," which consists of millions of sealed cells and is unaffected by most acids and solvents and completely impervious to moisture, provides the constant insulating efficiency, corrosion resistance, and incombustibility necessary to convert saline water by a freezing process.

The system, developed by Dr. H. F. Wegandt of Cornell University and the Blaw-Knox Co. of Pittsburgh, Pa., is designed to produce 35,000 gal. of fresh water daily at a target price of not more than 50 cents per 1,000 gal. It involves pumping salt water and liquid butane into the tower shown here or into a rotating basket device, pulling heat from the salt water as the butane turns to gas, and draining off the brine from the resulting slurry of ice. The ice crystals are washed clear of any remaining salt and melted by



Layers of cellular glass up to 2½ in. thick insulate all surfaces and piping of the missile-shaped melter-washer tower at the new salt water conversion plant in St. Petersburg, Fla.

the heat throw-off from butane gas under pressure.

If successful, this process will represent a major break-through in efforts to halt the drain on dwindling fresh water resources. *Pittsburgh Corning Corp.*

Reader Service Card: Circle No. 69

CATALOGS RECEIVED

Windshield and backlight replacement (23 pages). Illustrated manual giving detailed instructions and diagrams on the removal of old and installation of new windshields and backlights for all General Motors standard and compact model automobiles. *Libbey-Owens-Ford Glass Co.*

Reader Service Card: Circle No. 70

Creative ideas in glass (6 pages). Features buildings in which glare-reducing "Lustragray" glass has been used in windows and curtain walls. The modulation of daylight through glare-reducing glass in order to balance interior daylight and cut glare while admitting adequate illumination for good vision is discussed. *American-Saint Gobain Corp.*

Reader Service Card: Circle No. 71

NEW EQUIPMENT AND SUPPLIES

Nonacid Cleaner for Glass

"Film-Off," a product in use for some time, has been found to remove dirt and plaster deposits from outside construction without pitting or etching glass windows, aluminum sills, and

marble and terrazzo floors. Said to work well on brick, concrete, and ceramic tile, too, and to cut cleaning time in half, thus reducing maintenance costs considerably. *Huntington Lab., Inc.*

Reader Service Card: Circle No. 72

Compact Glass Gripper

Designed for dealers and distributors who handle glass. The holder consists of a circular piece of soft tissue with a heavy brown kraft paper backing. In use, the gripper is folded across the center of one edge of the glass, exposing a ½-in. strip of pressure-sensitive adhesive on the back which holds it in position against two opposite surfaces of the glass. *Libbey-Owens-Ford Glass Co.*

Reader Service Card: Circle No. 73

Specialized Silica Refractories

Do not crack or spall at temperatures which ordinarily break up conventional silica brick, according to laboratory tests. A number of applications of these new brands of brick have shown significant increases in service life. *Harbison-Walker Refractories Co.*

Reader Service Card: Circle No. 74

Tractor-Shovel

Model H-30 "Payloader" has an operating capacity of 3000 lb. It is currently being used by Kimble Glass Co. for moving cullet which weighs from 75 to 100 lb. per cu. ft. *Frank G. Hough Co.*

Reader Service Card: Circle No. 75

Danger of Slipping Accidents Reduced

The problem of moisture on a pedestrian ramp at the Brockway Glass Co. has been solved with the application of "Dura-Grip," a nonslip material which proves durable to wear. *Mine Safety Appliances Co.*

Reader Service Card: Circle No. 76

Air-Drying Solvent Solution

Is claimed to substantially increase the resistance of paper and paperboard products to water and weathering. Called "Impregnole 367," the new material is a mixture of silicone ploymers and other film-forming ingredients. Applied to finished boxes and sheet stock, it has already been used successfully for outdoor storage. *Sun Chemical Corp.*

Reader Service Card: Circle No. 77

Sand Conveyor-Collector

A pneumatic system with portable collector has been in operation at General Dynamics' electric boat division for several months, and indications are that it may have a valuable application in the glass industry. It has been reported that this equipment yields a better than 75 per cent saving in man hours in the unloading of foundry sand and blast cleaning grit, and shows exceptional service life. *Allen-Sherman-Hoff Co.*

Reader Service Card: Circle No. 78

Ink-Cartridge Meter Marking

A capillary system drawing ink from a disposable cartridge is substituted for the conventional manually-filled, open-bucket type in a new marking device now undergoing field tests at Owens-Corning Fiberglas Corp.'s Barrington, N. J., plant, and other industrial locations. The cartridge, adaptable to all existing types of recorders, contains sufficient ink for several months of operation, and is presently being used on an instrument panel located less than 10 ft. from a glass furnace where temperatures range in the neighborhood of 2200°F. Improved reliability and substantial savings in service time and costs have been reported. *Esterbrook Pen Co.*

Reader Service Card: Circle No. 79

Fabric-Backed Urethane Liner

Specially designed for handling glass and other abrasive materials is said to reduce costs by protecting expensive chutes and equipment, providing maximum abrasion resistance and longer life, allowing use of thinner-gauge materials, and affording more economical installation and maintenance. *Industrial Div., Armstrong Cork Co.*

Reader Service Card: Circle No. 80

Radiation Pyrometer

Measures temperatures up to 4000°F in industrial heating furnaces, glass tanks, open hearth furnaces, and rotary kilns. Accurate within 1 per cent of temperature span, its 60-millivolt signal output at 2200°F permits the use of an ac receiver-recorder. *Bailey Meter Co.*

Reader Service Card: Circle No. 81

Cleaner Attacks Alkaline Solutions

Two new sequestrants, "Seqlene Fe-900 and Fe-1300," have been found to be effective in bottle washing, cleaning of glass molds, and similar operations involving control of magnesium and calcium "hard water" salts or scales. *A. E. Staley Mfg. Co.*

Reader Service Card: Circle No. 82

Safety Tape

For protecting hands, fingers, forearms and wrists against cuts, burns, and abrasions. The tape, called "Guard-Tex", is self-adhering and flexible, and conforms to finger contours without forming bulges or corners. It is applicable for handling sharp-edged glass sheets and hot glass, and is said to leave no fingerprints, lint, or smudge, an important factor in mirror manufacture. *General Bandages, Inc.*

Reader Service Card: Circle No. 83

CATALOGS RECEIVED

Better industrial lighting (16 pages). Booklet B-570 lists recommended foot-candle levels, discusses the quality factors in plant lighting, and explains the specific benefits of a properly lighted factory. *Better Light Better Sight Bureau.*

Reader Service Card: Circle No. 84

Combustion indicator (8 pages). Illustrated bulletin Q-2 describes the "Qual-O-Rimeter" indicator, outlining many potential applications. *Selas Corp. of America.*

Reader Service Card: Circle No. 85

Wire cloth (6 pages). A brochure commemorating the company's 50th anniversary and containing the history and available products in the line of conveyor belts, industrial wire cloth and wire cloth fabrications, and "Gripper" metal-mesh slings. *Cambridge Wire Cloth Co.*

Reader Service Card: Circle No. 86

Pivoting pyrometer detector system (4 pages). Process data sheet 705(3) describes the "Rayoscan" detector and its applications. Continuous, automatic monitoring of kiln shell temperatures is explained. *Leeds & Northrup Co.*

Reader Service Card: Circle No. 87

Residual fuel oil treatment (2 pages). Bulletin E1-159 describes a new product designed to minimize slag and corrosion in boiler systems. *Nalco Chemical Co.*

Reader Service Card: Circle No. 88

Basic brick products (2 pages each). Bulletins 32, 33, 34 and 35 cover CM30 and CM30B chrome-periclase brick, CM40, CM40B, and CM40R controlled composition chrome-periclase brick, MC70 and MC70B periclase chrome brick, and M90 and M90B high-purity periclase brick. *H. K. Porter Co., Inc.*

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INVENTIONS AND INVENTORS

Annealing and Tempering

Tempering of Sheet Material. Patent No. 2,948,990, Filed June 14, 1955. Issued August 16, 1960. One drawing; not reproduced. Assigned to Libbey-Owens-Ford Glass Company by Gerald White.

The present invention relates broadly to the tempering of sheet material and more particularly to an improved apparatus for tempering glass sheets or plates.

Glass sheets are placed on the molds along the conveyor section and pass through the heating furnace or chamber after which they are transferred onto the conveyor sections and moved through the quenching or tempering station. During passage through the tempering station the sheets may be quenched or cooled uniformly across their entire width by means of the longitudinally extending strips or layers of cooling medium flowing through the orifices of staggered upper and lower nozzles. The layers or strips of cooling medium coming from the nozzles are substantially parallel to the direction of travel of the sheets, and, if desired, directional fins or reflector plates may be used to deflect the cooling medium in a predetermined sweeping pattern. After passing through the quenching or tempering station, the sheets are transferred to the conveyor section and moved to the unloading conveyor.

There were 4 claims and the following references.

United States Patents

2,170,749, Forbes, Aug. 22, 1939; 2,188,401, Crowley, Jan. 30, 1940; 2,213,405, Paddock, Sept. 3, 1940; and 2,646,647, Bamford et al., July 28, 1953.

Foreign Patent

707,949, Germany, July 8, 1941.

Feeding and Forming

Apparatus for Manufacturing Glass Beads. Patent No. 2,947,115. Filed December 1, 1955. Issued August 2, 1960. One drawing; not reproduced. By Thomas K. Wood.

The present invention relates to apparatus for producing glass beads and constitutes an improvement over the prior art.

It is an object of this invention to provide apparatus for the manufacture of glass beads in which those portions of the apparatus on which accumulations of molten or semi-molten glass particles are likely to form are set into vibratory motion to sharply reduce the rate of formation of such accumulations.

The method provides a vibrator such as the magnetic vibrators frequently used in conveying systems, which operates at a relatively high frequency to set the draft tube into vibratory motion

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during periods of use. While the hammering technique depends upon the accumulation of a certain amount of aggregated particles which are periodically knocked off as icicles of substantial size, the vibratory motion appears to reduce the rate of accumulation of particles or at least reduce the rate of build-up.

There were 3 claims and the following references cited in this patent.

United States Patents

2,229,037, Boldman, Jan. 21, 1941; 2,334,578, Potters, Nov. 16, 1943; 2,572,484, Howle et al., Oct. 23, 1951; and 2,619,776, Potters Dec. 2, 1952.

Glass Wool and Fiber

Manufacture of Glass Fibers. Patent No. 2,947,027. Filed January 16, 1952. Issued August 2, 1960. Two sheets of drawings; none reproduced. Assigned to Owens-Corning Fiberglas Corporation by Games Slayter.

The invention relates to the process in which glass in a molten condition is flowed into a plurality of streams, and the streams are individually attenuated into fine fibers.

In the present case the glass, as it is flowed into the stream from which the fiber is attenuated, is strung out into a multiplicity of minute streamlets each of exceedingly small diameter, and by this operation the glass is hydraulically worked to be conditioned to provide the desired improved properties in the fiber.

These aggregates of molecules apparently are the result of incipient crystallization, that is, the molecules have started to become oriented and collected in the position they would have if the glass were crystallized, but this action has not proceeded to the crystalline state. Evidences of this precrystalline state or incipient crystallization have been observed in electron micrographs of very fine glass fibers.

When glass that is in this state of incipient crystalization is strung out into exceedingly fine streamlets, that is, streams having diameters in the order of a thousandth or less of an inch in diameter, these aggregates of molecules, or incipient crystals, may be strung out into oriented arrangements which contribute to increased strength and possibly also greater resistance to fracture of the glass. This stringing out of the glass is accomplished by passing the glass as it flows to the fiber forming zone through minute passages or tubules which subdivide the glass into a multiplicity of fine streamlets, which are then recombined into a larger stream, which is immediatley attenuated into a fiber.

The glass is rapidly cooled throughout this operation of subdivision, recombining and attenuation, so that any orientation imparted to the molecular structure of the glass is quickly frozen into the glass as the glass solidifies.

There were 2 claims and 18 references.

Sheet and Plate Glass

Apparatus for Manufacturing Ornamented Flat Glass. Patent No. 2,951,315. Filed December 12, 1955. Issued September 6, 1960. Two drawings; none reproduced. Assigned to Pilkington Brothers Limited by Frank Cousen, and George H. Oxley.

This invention relates to improvements in or relating to apparatus for manufacturing ornamented flat glass in ribbon form. The apparatus comprises on one side of a main roller the means for flowing a ribbon of glass over the crown of the roller and, on the other side of the main roller, means

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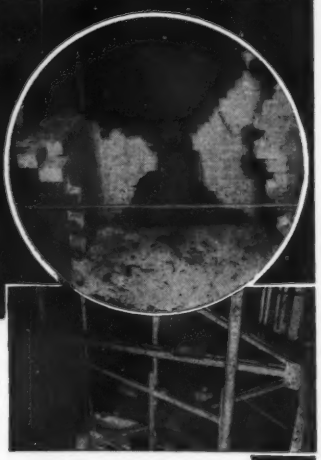

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for flowing a ribbon of glass to the ribbon on the crown of the main roller. A pressure roller is operatively associated with the main roller to exert a pressure on the glass leaving the main roller so as to constitute the desired ultimate ribbon. There is a hopper for the frit which is disposed over the zone and means for vibrating the hopper, whereby frit in the hopper may be caused to fall on to the surface of the first ribbon exposed over the main roller. The method thus provides that the first component ribbon is formed by rolling and an ornamental pattern is impressed on its upper surface as it is rolled into the ribbon form. Both transparent and opaque decorations may be attained.

There were three claims and eleven references cited in this patent.

Method and Apparatus for Producing Sheet Glass. Patent No. 2,957,275. Filed August 5, 1955. Issued October 25, 1960. One drawing; not reproduced. Assigned to Libbey-Owens-Ford Glass Company by Curtis W. Davis and Delmar E. Carney.

In order to alleviate the tendency of the glass to chip and fracture as it is being surfaced, it has been found that by properly shaping the edge of the glass sheet before it is annealed that the edge portions might be depressed slightly from the plane of the major surface of the sheet. This shaping of the glass ribbon before it reaches the annealing lehr has been accomplished by contouring the upper forming roll such that the edge portions of the sheet will be made slightly thinner, according to a predetermined curvature, than the remaining central and major portion of the sheet. While it has been proposed in the past to contour the forming rolls in one way or another to produce a flat area along the central portion of the sheet or ribbon, the forming rolls of the invention have been specifically contoured to reduce the thickness of the sheet along the edges or to dispose the edges below the major surface area of the sheet for the purpose of reducing breakage during surfacing.

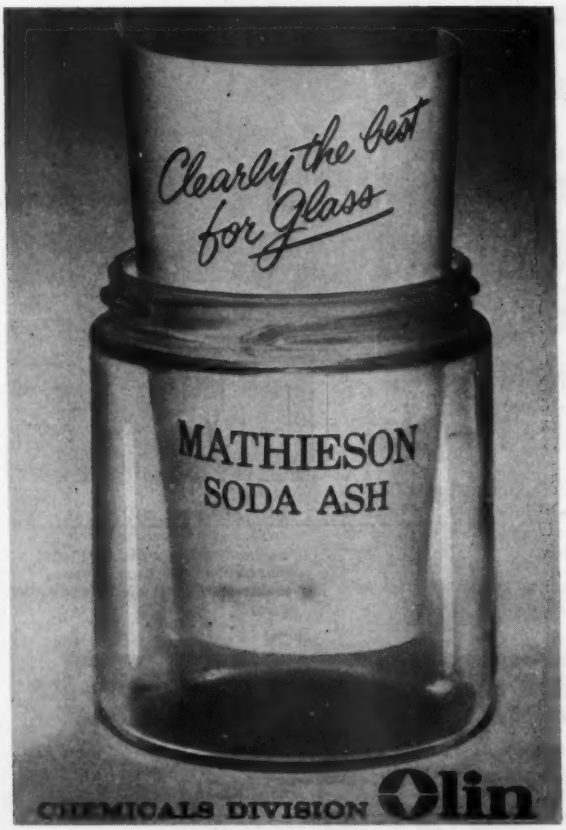
It was therefore found that if the glass sheet or ribbon were treated along the edge portions and reduced in thickness in a predetermined manner before passing to the annealing lehr, that the bulb which normally formed along the edge portion thereof could be depressed below the major surface area of the sheet, and the problem of the grinding wheels or discs engaging the edges before the main central surface area could be eliminated.

There were 4 claims and the following references cited in this patent.

United States Patents

697,229, Appert, Apr. 8, 1902; 1,560,078, Gelstharp, Nov. 3, 1925; 1,608,657, Howard, Nov. 30, 1926; 1,759,225, Drake, May 20, 1930; 2,270,362, Waldron, Jan. 20, 1942; and 2,272,651, Waldron, Feb. 10, 1942.

(*Continued on page* 282)



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Circle No. 25

CURRENT STATISTICAL POSITION OF GLASS

Employment in the glass industry during January, 1961, was as follows: *Flat Glass*: a preliminary figure of 25,000 for January, 1961, indicates a decrease of 6.01 per cent under the adjusted figure of 26,600 for December, 1960. *Glass and Glassware, Pressed and Blown*: a decrease of 3.3 per cent is shown by the preliminary figure of 82,600 reported for January, 1961, when compared with the adjusted figure of 85,500 reported for December, 1960. *Glass Products Made of Purchased Glass*: the preliminary figure of 12,800 given for January, 1961, is 9.8 per cent under the adjusted figure of 14,200 reported for December, 1960.

Payrolls in the glass industry during January, 1961, were as follows: *Flat Glass*: a decrease of 13.6 per cent is shown in the preliminary $13,460,464.50 given for January, 1961 when compared with December's $15,016,938.76. *Glass and Glassware, Pressed and Blown*: a decrease of 0.9 per cent is shown in the preliminary $33,474,929.47 given for January, 1961, when compared with the previous month's adjusted $33,809,229.09. *Glass Products Made of Purchased Glass*: a preliminary figure of $4,303,986.23 was reported for January, 1961. This is a decrease of 10.7 per cent when compared with the adjusted figure of $4,822,611.67 for December.

Glass Container Production based on figures released by the Bureau of the Census, Industry Division was 12,482,000 gross during February, 1961. This is an increase of 1.5 per cent over the previous month's production figure of 12,287,000 gross. During February, 1960, glass container production was 13,131,000 gross, or 5.2 per cent more than the February, 1961 figure. At the end of the first two months of 1961, glass container manufacturers have produced a preliminary total of 24,769,000 gross. This is 4.5 per cent less than the 25,960,000 gross produced during the same period in 1960.

Glass Container Shipments during February, 1961, came to 11,262,000 gross, a decrease of 2.8 per cent under the January figure of 11,594,000, gross. Shipments during February, 1960, amounted to 11,460,000 gross, or 1.7 per cent more than February, 1961. At the end of the first two months of 1961, shipments have reached a prelinimary total of 22,856,000 gross which is 0.6 per cent more than the 22,728,000 gross shipped during the same period of the previous year.

Stocks on hand at the end of February, 1961, came to 21,830,000 gross. This is 5.5 per cent more than the 20,613,000 gross on hand at the end of January, 1961, and 6.8 per cent more than the 20,423,000 gross on hand at the end of February, 1960.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

Narrow Neck Containers

	February, 1961
Food	1,091,000
Medicinal and Health Supplies	1,317,000
Chemical, Household and Industrial	866,000
Toiletries and Cosmetics	824,000
Beverage, Returnable	458,000
Beverage, Nonreturnable	138,000
Beer, Returnable	101,000
Beer, Nonreturnable	985,000
Liquor	819,000
Wine	376,000
Subtotal (Narrow)	6,975,000

Wide Mouth Containers

Food	*3,237,000
Medicinal and Health Supplies	374,000
Chemical, Household and Industrial	127,000
Toiletries and Cosmetics	286,000
Dairy Products	141,000
Subtotal (Wide)	*4,165,000
Total Domestic	11,140,000
Export Shipments	*122,000
TOTAL SHIPMENTS	*11,262,000

* This figure includes Fruit Jars, Jelly Glasses, and Packers' Tumblers.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production February 1961	Stocks February 1961
Food, Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics.	Narrow Neck	4,476,000	7,210,000
	Wide Mouth	*4,275,000	*6,545,000
Beverage, Returnable		744,000	2,647,000
Beverage, Nonreturnable		150,000	381,000
Beer, Returnable		241,000	683,000
Beer, Nonreturnable		1,272,000	1,659,000
Liquor		777,000	1,575,000
Wine		405,000	813,000
Dairy Products		142,000	317,000
TOTAL		*12,482,000	*21,830,000

* This figure includes Fruit Jars, Jelly Glasses, and Packers' Tumblers.

INVENTIONS AND INVENTORS

(*Continued from page* 278)

Method for Cleaving Glass Sheets and New Articles of Manufacture Thereby Obtained. Patent No. 2,959,507. Filed May 31, 1957. Issued November 8, 1960. Three sheets of drawings; none reproduced. Assigned to Glaces de Boussois, S.A. by Bernard Long.

Laminated glass for windows of automotive vehicles, and the like, has heretofore been manufactured by joining two sheets of glass together with a thin plastic interlayer disposed between the sheets to bond them together upon the application of heat. In order to obtain the most desirable optical characteristics, the faces of each of the glass sheets which make up the laminated sheet are ground and polished.

This invention eliminates the need for grinding and polishing the mating faces of laminated glass sheets by providing a method for cleaving a glass sheet into separate sheets which can be accurately mated together to obtain a laminated glass sheet having optical characteristics approaching those of the original glass sheet before it was cleaved.

There were 11 claims and 13 references.

Glass Compositions

Silica Glass. Patent No. 2,958,604. Filed July 10, 1957. Issued November 1, 1960. No drawings. Assigned to Quartz and Silice S.A. by Henri J. C. George.

The present invention provides a silica glass which may be rendered only very slightly radioactive but which suffers no loss of transparency on exposure to high-energy radiation. The glass of this invention may accordingly be used advantageously in nuclear installations where its transparency may be appreciated without any significant concomitant induced radioactivity.

In general, the silica glass of this invention consists of substantially pure vitreous silica in combination with a small and limited proportion of cerium oxide together with which the silica is fused. The cerium oxide is conveniently incorporated by adding a solution of a cerium salt to granulated pure silica (e.g. quartz) preliminary to its fusion to silica glass and then adding a volatile base such as ammonia hydroxide to precipitate cerium hydroxide. The granulated silica is then dried and fused to yield a product consisting essentially of pure silica and cerium oxide. The amount of cerium necessary to attain effect is generally between about 5×10^{-4} and 10^{-3} parts of cerium expressed as CeO_2 per part of silica.

Any of numerous soluble salts of cerium are suitable, such as the bromide, iodide, nitrate, sulfate, and chloride. The chloride is preferred. Fusion is preferably carried out under a vacuum in an electric induction furnace. After fusion, the silica glass is cooled and further processed into tubings, vessels, windows, or other articles in conventional manner.

There were 4 claims and the following references.

United States Patents

1,414,715, Taylor, May 2, 1922; 1,637,439, Coblentz, Aug. 2, 1927; 2,515,938, Stookey, July 18, 1950.

Glass Compositions and Glass-To-Metal Seals. Patent No. 2,948,992. Filed February 21, 1958 (Claims priority, application Great Britain, February 21, 1957). Issued August 16, 1960. One drawing; not reproduced. Assigned to The General Electric Company Limited, a British company, by Lucy Florence Oldfield and John Henry Partridge, deceased, by Ethel Partridge and Michael John Anthony Partridge, administrators.

This invention relates to glasses suitable for sealing directly to nickel and to other metals and alloys having thermal expansion characteristics similar to those of nickel, that is to say having mean coefficients of thermal expansion over the temperature ranges of 20°C to 450°C and 20°C to 500°C, which do not differ from those of nickel over the same temperature ranges by more than 0.5×10^{-6} cm./cm.°C.

Composition of specific glasses A through G in accordance with the invention are given in the following table.

Composition	A	B	C	D	E	F	G
SiO_2	48.0	47.0	50.0	50.0	48.0	48.0	4 .0
Na_2O	21.0	20.5	13.0	13.0	20.5	21.0	2 .5
K_2O	—	—	8.0	8.0	—	—	— —
BaO	8.5	9.5	8.0	8.0	9.5	8.5	.0
SrO	10.0	10.0	10.0	10.0	10.0	10.0	1 .0
CaO	3.0	4.0	3.0	3.0	3.0	3.0	.0
F_2	1.5	1.5	—	—	2.0	2.0	.0
Al_2O_3	1.0	1.0	1.0	1.0	1.0	1.0	.0
ZnO	5.0	5.0	5.0	5.0	5.0	6.0	.0
ZrO_2	2.0	1.5	2.0	—	2.0	1.0	.0
TiO_2	—	—	—	2.0	—	—	— —

There were 8 claims and 18 references.

COLOR IN HAND-BLOWN GLASS

(*Continued from page* 243)

Stained Glass

Another hand-blown product, flat glass, is used mostly in church and public building installations for decorative purposes. It is often called stained glass because of the ceramic paint glass studio artists affix to it. Blenko is the only domestic source of antique glass, a type of flat glass. The main difference between this and other types of flat glass is that it is not rolled smooth. The resulting variation in thickness tends to pick up the color of the light values better.

The muff process is used to make the glass. A single pane is made by blowing a gather into a cylinder 18 in. long with a diameter of 8 in. An electrically heated wire is used to snip off each end, and the glass is conditioned against breakage in the annealing lehr. Later it is reheated and split with a glass cutter. The heat actually flattens the glass, and a steel pole is the only tool used to hasten the process.

Large Range of Color

Because of the glass studio's exacting requirements, a vast color source must be available. Although an artist paints a flat glass, he is only adding to its basic hue, never changing it. The only exception is silver which, when applied to flat glass, results in yellow.

To insure color accuracy, Blenko keeps batch records of all melts along with a master color rack. At the

moment, approximately 1500 shades of colors are on file. Whenever a melt is made, it must match the master sample. Since they may differ because of impurities and varying furnace conditions, this check is necessary. Sometimes a color such as a flesh tone may turn out a little browner, a little pinker, or a little greener than the master sample.

Practically all known metals are used in color making, either singly or in combination with others. Commonly used metals include oxides of copper to produce blue, iron oxides for green, and carbon for yellow.

The following are several metals that are sources of the colors so much in demand for today's home furnishings market.

Selenium	pink
Cobalt	violet
Chrome	yellow green
Manganese	purple
Gold	ruby
Neodymium	violet
Nickel	brown
Sulfur	amber
Uranium	yellow

Color Selection

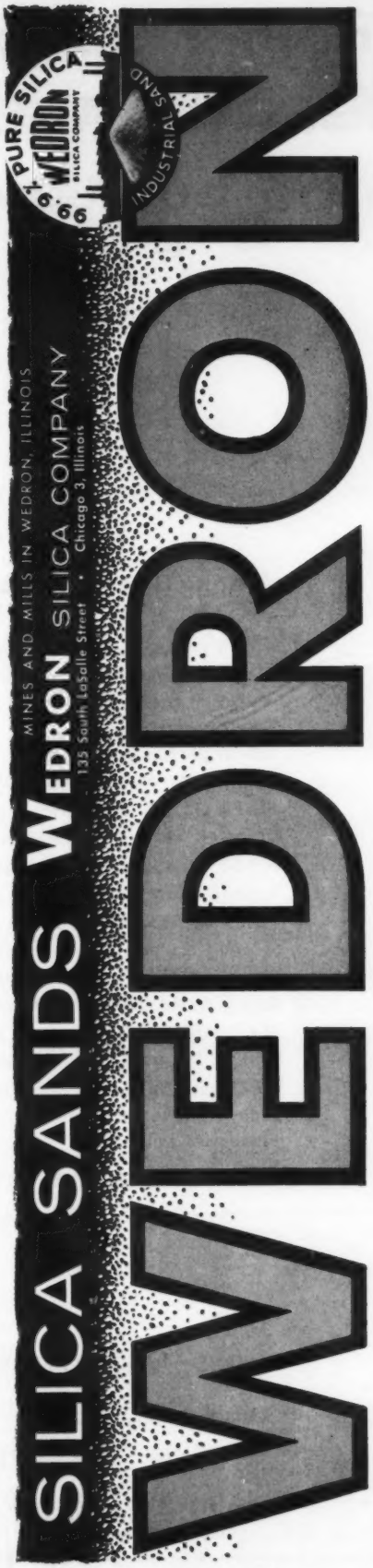
When a glass manufacturer selects a color group, he considers the characteristics of the material, color preferences of his potential customer, and color trends in the home furnishings field.

In sunlight, glass attains its maximum beauty. The light gives life to the glass, highlighting the bubble flecks and ridges in it; however, the glass also has a tendency to wash out. To counteract this, colors selected should be strong in character, never weak.

The industry's potential customer, according to psychological tests, is an individual who reacts to color and has a natural love for it. No two people see the same color in the same way. The average person cannot even recall a specific color accurately, but she knows what pleases her and whether or not a specific color is suited for use in her home.

Studying the customers' buying habits over a long period of time has resulted in a color selection method which Blenko calls the 'vacuum' principle, i.e., studies show that color popularity tends to run in a 6- to 8-year cycle. After a shade is introduced, it normally takes the customer about 2 years to become used to it. During the third and fourth year it will be most popular, and then gradually decline. At the moment Blenko's 'tangerine' is in the middle of the cycle. Once the trend-setting consumer becomes accustomed to a shade, and although it may still be extremely popular, she is aware of a conspicuously absent tone. It is this lack or 'vacuum' that causes a demand for a new color.

Actually, this demand arises from a 'conditioned' vacuum. For a minimum of two years, the customer has come in contact with a specific shade, perhaps brighter or deeper than anything on the market in the past. Continuing contact causes acceptance which is the groundwork for a new color. For example, tangerine, now popular in the volume market has a high yellow



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content. Highly trend-conscious customers at the moment are choosing jonquil, the 'conditioned-vacuum' color, for their homes. Influence is achieved in different ways—exposure in editorial pages of home furnishings magazines, color-motivated store promotions, advertising, and color TV.

Timing is of the utmost importance. Any shade marketed too early or too late will result in a staggering inventory. The vacuum theory can help to eliminate this. During the introductory period, department stores, specialty and gift shops order the new tone for their extremely color-keen clientele, perhaps in small quantities, while ordering popular shades in depth. Color evolvement occurs in the home furnishings field at a slower pace than, say, the ready-to-wear market, and this buying method allows one line to serve two distinct markets.

By breaking down the results of color cycle studies into geographical regions, some interesting buying patterns can be noted. Purchasers in predominantly cold northern regions such as New England, Wisconsin and Minnesota, tend to select cool amethyst, blue, and green. Those in areas similar to California and Texas lean toward warmer colors such as orange, yellow, and red. Possibly, this may be the result of the climate itself and the mode of living it encourages, as well as of cultural differences.

Relationship of Color to Shape

Certain forms are enhanced more by one color than another. Yet this is a subtle and difficult characteristic of color to observe. A very soft and supple, gently flowing form may appear better in a grey or soft blue, while an angular and crisp silhouette will be more pleasing in red or a hard color.

The shape itself is dependent upon design trends. Since design is a philosophy, it is subject to constant change. It reflects the times, architectural innovations, and new modes of living. The designer must also be conscious of the axiom, "Truth to material and to the process used to form it." This is in opposition to style which requires only the fitting of material to some preconceived shape.

Although shapes change from year to year, American glass producers have a recognizable design tradition. At Blenko the tradition is English, which calls for emphasis on the actual shape rather than on any ornamentation.

Nature, with all its phenomenal symmetry, is an important source of design inspiration. In the present Blenko line there is a decanter that resembles the stamen of a flower. Fruit and abstract tree forms have also been the inspiration of many pieces.

Many, many glass pieces are designed, blown, and tested repeatedly before a group is finally selected for production. This testing period, when difficult technical problems can be analyzed and worked out, is the source of new and stimulating design innovations. *(The End)*

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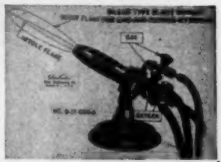

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Circle No. 31

GLASS SURFACE DETERIORATION

(*Continued from page* 248)

by comparison of the peaks in the transmission curves. It was found that the stained glass peaked at 9.25 microns in contrast to 9.5 microns for unexposed polished plate glass.

An attempt to differentiate between scum and stain was made by the use of a scribed reference mark on the glass in conjuction with a Zeiss interference microscope. In Fig. 10a, the interferogram shows the initial surface to be relatively smooth except for the band deflection over the scribed reference mark. In Fig. 10b, the same glass surface with heavy scum shows that the band deflection for the scummed area is opposite to the direction of the band deflection for the scribed mark. Thus, scum is an accumulation. Fig. 10c shows the same glass surface as in 10b but after a thorough cleaning with pumice and water. This remaining deteriorated surface condition is classified as stain, and the band deflections over the stain area are in the same direction as the band deflections over the reference scratch. Such similarity in band deflection indicates that the stain is in this case an etching process causing permanent damage to the glass.

The relationship between scum and stain can be obtained by making comparisons between Fig. 10b and 10c. Scum on the 10b surface shows an accumulation of over 1 micron, while stain shows penetration from 100 to 350 millimicrons. Other measurements of scum show that accumulations from 200 to 400 millimicrons can occur without any permanent stain. However, on most glass surfaces where scum has developed, stain usually occurs simultaneously. Stain in most stages is objectionable and may appear as random pitting, iridescent colorations, and severe etching.

V. Conclusions

An attempt is made to describe surface deterioration mechanisms for soda-lime glass. Moisture-vapor attack is a process that may initiate through:

1. Preferential adsorption.
2. Condensation.
3. Solution reaction.

Scumming is an accumulation appearing as either amorphous or crystalline materials containing alkaline hydrates, carbonates and silicates. Staining, on the other hand, is a permanent deterioration of the surface as is evidenced by deep etching, by severe pitting, by spalling out of irregular surface areas and by iridescent colorations.

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THE CHALLENGE OF FIBER GLASS

(*Continued from page* 260)

the operator. The finish of the trim is acquired by the application of a special "thin fiber glass veil" on top after cure. Following an edge trimming operation after press and cure are completed, various pieces of trim are cut to the desired angles. Because six pieces of trim are required for the typical billboard, different angle cuts are necessary, some 45° and some 90°. This finished fiber glass trim is being used widely by outdoor advertisers, and so far, reports indicate that after as much as 3 years of exposure, it shows no signs of fading or appreciable weathering.

Until recently, all water skis had been made from wood. Now this application is one of Kimball's fastest-growing fiber glass operations, involving, however, a number of challenging design problems. After much experimentation, it was found that the best ski size is about 5½ ft. long and 7 in. wide, a happy medium which takes into consideration the average weight and size of skiers and the most popular marine engine horsepowers. Each fiber glass ski weighs a little under 6 lb. as compared to 8½ lb. for conventional types. For maneuverability, a ski that is curved somewhat like the rocker on an oldfashioned chair—though not so sharply—was felt to be most desirable. By tapering both ends of the ski—not just the front as in other types—it was discovered that both ride and control were improved. To further increase these capacities, a specially designed fin was added to the aft end. A suitable mold was designed and manufactured, and the first skis produced were given extensive tests on the water and with testing apparatus.

The procedure for fabricating these skis, currently being turned out at the rate of thousands every year, is somewhat similar to that for producing billboard trim. Fiber glass mat is carefully laid over a balsa wood core and polyester resin (Fig. 6) added along with an outside layer of special cloth on which a colored pattern is printed. The ski is pressed into the mold and trimmed. Foot bindings, fins, and other accessories also formed in special molds are added later.

The resins used (all unsaturated polyesters) are stored in 3000-gal. stainless steel tanks located in a fireproof concrete block enclosure within the plant. Stainless steel, used in both tanks and resin piping facilities, insures a minimum of contamination. Resins are pumped to shear-type mixers in an adjacent room where they are compounded for color and appearance. For some of the fancier shapes, Kimball has developed a premix material compounded in a heavy-duty double sigma arm mixer.

All of these advancement technique and design indicate that, as a material with vast industrial and commercial potential, fiber glass will undoubtedly continue to demand the utmost in ingenuity and modernization on the part of processors, molders, and fabricators. *(The End)*

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